

SECTION M.

FORESTRY AND HYBRID COTTONWOODS

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Forestry

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Undesirable woody and herbaceous plants are problems in managed forests and on fence lines and rights-of-way. Safe, dependable methods of chemical weed control have been developed for most forestry needs. Reforestation, in particular, may depend heavily on weed control. Depending on local conditions and weed composition, the results sought differ strikingly in degree of control and composition of residual vegetation and, hence, in the choice of method. The Oregon Forest Practices Act mandates successful reforestation after logging, even in riparian areas. It also prescribes certain rules regarding herbicide use to protect plantations, forest resources, and water. Operators should be familiar with these rules and labels whenever herbicides are used. A variety of chemicals are used to control forest weeds. Any product used in various forestry applications must be EPA-registered for that use. Products not carrying a forest, reforestation, forest management, conifer plantation, or similar use on their labels must not be used in the forest, even if they have active ingredients that are registered somewhere else for forest use.

Forest Land Weed and Brush Control

The objective of weed or brush control in commercial forests is to provide increased seedling survival leading to larger, higher quality harvests, and reduction in time required to bring the crop to maturity. Objectives also include protection of wildlife habitat and water quality. In the past 20 years, research has made clear that virtually no other practice will produce as much gain in plantation performance as reducing competing cover, and that careful application of the appropriate chemicals exceeds other methods in safety, cost and habitat protection for most operations.

Growing trees is the ultimate objective, not killing brush; brush/weed control is merely a phase of the reforestation procedure, after which the trees themselves dominate virtually every other kind of plant where they grow. Selective vegetation control is an efficient method of enhancing certain kinds of wildlife habitat.

Weed control enhances conifer survival and growth. On harsh sites in southwestern and eastern Oregon, almost total weed control is essential even to obtain survival, and it may be necessary to maintain a weed-free site for more than two years. On better sites in the Coast Range, although initially weeding may not be essential for survival, fast-growing herbs and brush will threaten survival within a few years. Treatment to prevent onset of brush problems will greatly enhance productivity. Indeed, weeding pays best on the best sites, even though the percentage increase is greatest in poorer sites.

Vegetation Control with Nonchemical Methods

Some weeds lend themselves reasonably well to removal without chemicals. Alder more than 2 inches in diameter can be killed fairly well by cutting at the ground line from mid-June to mid-August. Smaller stems are more likely to sprout at any time. Fungi complement the cutting to help kill stumps if done in summer. Alders cut at other times are likely to sprout vigorously. Most other western Oregon and Washington hardwoods sprout if cut at any time; chemical treatment improves results.

Grazing intensively This method can, in some circumstances, remove palatable herbs and certain brush species (not scotch broom, however). Great care is required when grazing among conifers to keep animals out of plantations when trees are actively growing. Grazing is among the most difficult methods of control because weed removal must be relatively complete to provide significant benefits, and this degree of control is difficult to achieve without animal damage to trees. However, intensive pasturing of a cut-over hardwood stand for the two years immediately after logging will remove or reduce vigor of many of the sprouting brush species and may help simplify the weeding job to herb removal only. However, herbs may recover too quickly for this procedure to do the whole job of site preparation.

The need to reduce cover to very low levels means the livestock will not gain weight well in programs such as this. If they are not grazed to this intensity, some supplemental weeding will be necessary.

Paper mulch This method has had success comparable to that of grass herbicides. In southwestern Oregon, and near the state's Willamette Valley, mulch paper should be at least 9 sq ft (3 ft x 3 ft). On coastal areas and in western Washington, 4 sq ft (2 ft x 2 ft) should be adequate. Mulch paper should be fiber-reinforced, laminated Kraft paper with an asphalt core for adequate durability. Mulch paper must be well weighted on all four corners, or pinned to the ground. Clear plastic will not work. Black plastic will work and is lightweight but difficult to handle.

Mechanical tillage Using heavy equipment to till forest soil has limited value on cutover land because of stumps, logs, and other obstacles. Recent trials of large subsoil or ripping equipment have shown promise on compacted soil and clay soils with restricted drainage, leading to easier planting and better root development. The procedure is not a truly effective weed control measure, however, and usually should be preceded or followed by an herbicide application to postpone weed development. If vegetation is controlled in spring before summer tillage, less horsepower/energy is required for the tillage.

In some circumstances, scarification with a bulldozer is feasible. Use toothed or conventional blades to remove brush on gentle topography. Do this when soil is very dry to minimize damage. Combining partial scarification with chemicals often offers the advantages of both procedures. In any event, keep soil compaction to a minimum. The operator should anticipate that scarification may set up a seedbed for an entirely new weed problem that can compromise results. Follow-up weed control is often needed. Burn or scatter piles of brush to improve plantability and reduce animal damage.

Vegetation Control with Herbicides

The methods selected to apply herbicides for weed and brush control depend on the species composition, proximity of crops, degree of control required, and available equipment. Method and season of application also have a major influence on degree of selectivity. The “best” method to use will depend on the project scale, terrain, type and size of vegetation, and will range from aerial applications to treating individual stems. The commonly used control methods and typical herbicides used are described below, with special emphasis on objectives, formulations, and equipment peculiar to each.

Major Herbicides and Common Brand Names of Forest Management Products

Herbicide Name	Common Brand Names
2,4-D ester	Weedone LV-4, Weedone LV-6 and others
Aminopyralid + metsulfuron	Opensight
Aminopyralid + triclopyr	Capstone
Atrazine	Aatrex 4L, Atrazine 4L, Atrazine 90 and others
Clopyralid	Transline and others
Flazasulfuron	Mission
Fluroxypyr	Vista XRT
Glyphosate	Rodeo, Accord XRT II, Roundup Custom, and many others
Hexazinone	Velpar L, Velpar DF
Imazapyr (2 lb ae/gal)	Chopper, Polaris SP, Rotary 2 SL, and others
Imazapyr (4 lb ae/gal)	Arsenal Applicators Concentrate, Polaris AC, Imazapyr 4 SL and others
Indaziflam	Esplanade F
Metsulfuron	Escort, MSM and others
Penoxsulam + oxyfluorfen	Cleantraxx
Picloram	Tordon 101, Tordon K and others
Sethoxydim	Segment II
Sulfometuron	Oust XP, Spyder and others
Triclopyr ester	Garlon 4 Ultra and others
Triclopyr salts	Garlon 3A, Vastlan and others

Herbicides sold as commercial products vary in their concentration of active ingredients. Different brands of a given active ingredient may have varying concentrations. When calculating how much product to use for a given application, make sure the calculation of dosage starts with amount of active ingredient (ai), and add whatever amount of product is required to provide that amount of

active agent. This section describes applications of many chemicals in various applications. It ALWAYS gives application rates in terms of ACTIVE ingredients. If a product has 4 lb ai/gal, and an application calls for one pound of the active portion of the product/acre, then the rate of product used is one quart per acre. Do not confuse these terms, lest over- or under-dosage results. Some hormone-type products are formulated as amine salts (water soluble) or esters (oil soluble, often water emulsifiable). Active ingredients are described in terms of percent ester or amine salt, and also as acid equivalent (ae). Use ae for determining the proper mixture when diluting for application.

Release treatments are designed to free conifers from competing vegetation. Several products can be used selectively for over-the-top broadcast conifer release. Most applications occur when conifers are dormant, usually before budbreak in the spring or after bud set in the late summer. Fluroxypyr is registered for selective blackberry and brush control in conifer plantations including ponderosa pine. Clopyralid is useful for elderberry and thistle control. Triclopyr and 2,4-D can be used selectively (but avoid high rates; see label) over Douglas-fir seedlings but will injure ponderosa pine and noble fir. Glyphosate and imazapyr can be used selectively to favor conifers only in late summer or early fall. Glyphosate is highly effective only on deciduous and herbaceous species in full foliage development. In fall, glyphosate will selectively remove brush and herbs from conifers. In midsummer, glyphosate damages conifers and brush severely. Imazapyr is active on maple, alder, and other brush as a growth inhibitor. It also damages conifers when applied to foliage during the growing season. Imazapyr is well adapted for trunk injection or spot treatments. Triclopyr salt formulations may be injected as a concentrate as well.

Site preparation applications before conifers are planted utilize the same products as conifer release but at higher rates and during seasons that would injure seedlings. Some products are registered only for site preparation. Aminopyralid, is registered for use to control broadleaf weeds and some brush in forests or on forest roadsides (non-crop) use. The product with aminopyralid alone, Milestone, is permitted only on roadsides, whereas the combination of aminopyralid and triclopyr amine (Capstone) is permitted for use in forests for site preparation, directed spray and cut surface applications (see the label for specific uses). The combination of aminopyralid and metsulfuron (Opensight) has received supplemental labeling in Oregon, Washington and Idaho. Aminopyralid has soil activity; overdosing near conifers can result in conifer injury through root uptake. Planting four months after application is recommended.

Picloram and metsulfuron nearly always harm conifers when applied directly so use is confined to site preparation. Picloram is federally restricted because of its mobility and high potential for damaging crops if it appears in irrigation water; use it with this in mind. Note restrictions on the label when grazing treated areas. Metsulfuron is used at rates much lower than rates for most other products and is useful at present only for site preparation and directed spraying. It is highly effective on blackberries, ferns and deciduous brush when applied before timber harvest to prevent postharvest sprout growth.

Grass and weed control in conifer plantations is covered at the end of this chapter.

Foliage Application

Foliage spraying is extensively used. Selectivity for conifers (release sprays) will depend on managing a host of variables such as season, timing, dosage, and species to be released or controlled. Brush

fields that are to be converted to conifer stands are best suited to summer foliage spraying before planting. Species such as vine maple (see tables later in this chapter for recommendations) may be satisfactorily controlled by this method, but only with highly systemic products such as glyphosate and imazapyr. Manzanita, *Ceanothus* spp., madrone, and other persistent-leaved brush species lend themselves to satisfactory control with foliage treatments of growth regulator products (e.g., 2,4-D or triclopyr esters) at any season from late dormancy until late midsummer, but treatments often work best in early spring.

The choice of season for controlling these species is determined in part by the availability of spray equipment and the presence or absence of susceptible crop trees. Check product labels carefully because optimum application times vary. For instance, conifer release works best in the fall when applying glyphosate to control alder, salmonberry, and thimbleberry. The optimum season for control of target species is usually midsummer, but that is also when many conifers are most sensitive. Optimum timing differs by herbicide used, and between site preparation and conifer release treatments. If spraying for selective release, never spray phenoxy herbicides over ponderosa pine in early spring, and do not attempt to release Douglas-fir when shoot elongation is more than an inch or two in length, or not yet hardened off.

Herbicides 2,4-D, aminopyralid, clopyralid, fluroxypyr, triclopyr, imazapyr, glyphosate, metsulfuron, and picloram are the herbicides used for foliage applications. For application rates, see the tables later in this chapter. Glyphosate plus imazapyr gives excellent control of mixed deciduous brush species. Picloram, aminopyralid, and metsulfuron are highly toxic to most conifers when applied directly, but seedlings planted the next season after treatment normally are unaffected. Water is almost always used as a carrier; in late summer a small amount of an oil additive (up to 5%) may be added to emulsifiable products including mixtures containing 2,4-D or triclopyr (see labels).

Adjuvants Surfactants and other adjuvants may be added to spray mixtures to enhance foliage activity. However, each commercial herbicide product may or may not have its own emulsifiers and wetting agents. Follow label recommendations on their use. Adjuvants do not always increase efficacy. Most (but not all) surfactants decrease selectivity in conifers. In general, adjuvants are not recommended if conifer selectivity is desired, unless experience shows conifer tolerance.

Application The choice of whether to spray foliage from the air or with ground equipment depends on the size of the job, stream buffer requirements, the equipment available and product registration (some products do not allow aerial application). For most small spray jobs, small equipment is most satisfactory. A backpack sprayer with adjustable cone nozzles can apply sprays at 3 to 10 gal/a quite uniformly (waving-wand technique) on cover less than 8 ft tall, if the applicator can move relatively freely. Note that most product labels show a minimum volume per acre that sets the lower limit. This technique is much faster than the spray-to-wet procedure, and wastes much less chemical.

The waving-wand backpack method of application is uniquely suited for treating small clearings and brush beneath a canopy of conifers or hardwoods being prepared for harvest, but is also well suited for larger areas and riparian zones where accessible on foot. These low-volume applications have great promise for allowing planting immediately after logging, if the pre-harvest application contains foliage-active products such as glyphosate/imazapyr, and soil-active materials such as sulfometuron. Preharvest treatment prevents perennial species from sprouting, and greatly simplifies postharvest

applications by preventing immediate green-up. When using the waving-wand technique for site preparation or release, it's important to keep the nozzle pointed above the target vegetation so the light spray comes down directly onto the foliage rather than cross-wise. Foliage is naturally designed to capture light from above, and this orientation also is excellent for catching a light spray. Wearing required personal protective equipment (PPE) as listed on the label is critical. For directions on this technique, read *Handbook of Weed and Insect Chemicals for Forest Resource Managers*, by M. Newton and F.B. Knight (Timber Press). For broadcast application rates, see recommendations in the following sections of this chapter for boom-less nozzles on ground rigs and aerial equipment. Volumes of total spray per acre suitable for aerial application work well, even at the lowest level. Always check and follow the label for minimum volume per acre allowed. Low volumes minimize labor cost as long as distribution is good. A recent publication describing the waving wand method appears in <https://ir.library.oregonstate.edu/downloads/rf55z810k?locale=en>

Aerial applications use 5 to 10 gal/a of spray mixture, as described on the label. Ground equipment is suitable for small jobs, but the labor required can be excessive on jobs of more than 40 acres; aerial application may be preferred. On large jobs, aerial spraying is a less expensive way to apply herbicides.

Herbicide selectivity and species composition Certain herbicides are effective on different mixtures of brush species and herbs. However, forest weed communities are far more diverse than agricultural fields, so several products may be required in a tank-mix. For example, if a recent cutover has developed a cover of grasses and forbs such as tansy ragwort and thistles—plus vine maple, elderberry, and salmonberry in the draws—a single product will merely change species composition. A site-preparation mixture for such a target group might include sulfometuron, glyphosate, and clopyralid, each at a dosage capable of removing a target species. This may be a costly prescription, but is much less costly than repeated applications, each of which may be inadequate. In tank-mixes, however, each product must not exceed the rate of application given on the label.

Dormant Application

Make most dormant applications when conifer buds have begun to swell but have not opened in late winter or early spring and before deciduous brush has leafed out. Water-soluble products generally are not used at this time. Dormant applications are used where Douglas-fir or true firs are established and require release from brush that is susceptible at this season. Unless the brush species retain green foliage during winter, oil is used for the herbicide carrier on bare deciduous brush stems. Emulsions containing oil may be as effective on the persistent-leaved evergreen brush. Pines, especially ponderosa, are sensitive to dormant sprays, particularly those containing oil, after the end of January. Sprays containing oil appreciably increase the cost of treatment, leading to decreased reliance on dormant sprays. Spraying well before bud swell may be best for Scotch broom.

Herbicides Triclopyr esters and 2,4-D ester are the most frequently used products in dormant applications. They are generally applied by helicopter in low volumes of oil or water-oil mixtures. Other types of ground apparatus are not well adapted to this type of treatment. There are no known substitutes for oil on stems of certain deciduous brush species and Scotch broom when there are no leaves. Water is appropriate on evergreen brush; adding a surfactant or 5% oil may improve results.

Basal Application

The basal application method is generally used to selectively treat individual woody plants. This method also lengthens the period of time that brush can be sprayed; basal applications are effective from January to November. For basal treatments, mix the herbicide with oil and apply completely around the lower 15 inches of a tree trunk or brush stem, soaking the trunk liberally to the ground line. Basal treatments usually control even larger hardwood trees with thick bark. Application is easiest if the base of the tree is scraped bare of moss and debris before treating. While allowing for selective brush control, this method can use a large amount of herbicide and oil. In some cases frill or stem injection can be faster and use less material. Spring applications may produce the best top kill, whereas summer and fall sprays may give better sprout control. Winter treatments may require a higher volume of spray with higher concentration as well.

Herbicides Basal sprays always are applied with oil as a carrier, using either one of the basal carrier oils now available, kerosene, or plant seed oils. Diesel oil can also be used since it is readily available, but is not as good of a carrier on some species because it can damage plant tissue and interfere with herbicide uptake. Rates are 4 to 20 lb ai of triclopyr ester herbicide (e.g., 1 to 5 gal Garlon 4 Ultra) to each 100 gal of oil used, or 1% to 5% by volume. The concentration used for basal sprays is much greater than for foliage sprays. For success, the stem must be soaked and thoroughly covered throughout the treatment area. Note that when trash is kicked away from the base, thinner bark is often exposed. If all of this is treated, thicker bark above may not need coverage. Results from basal treatments are not apparent immediately. Often the tree will leaf out and die back one or two years before finally dying. Incompletely covering the circumference leads to sprouting, and the entire tree is likely to survive.

LOW-VOLUME BASAL BARK TREATMENT

For susceptible woody plants with stems less than 6 inches in diameter at the base, mix 4 to 30 gal of a 4 lb ai triclopyr ester in enough oil to make 100 gal of spray mixture (4% to 30% by volume). Concentrations of 10 to 15 percent have provided good control on many Pacific Northwest species. Apply with backpack sprayer, using low pressure and a solid cone or flat fan nozzle. Spray basal parts of brush and tree trunks to thoroughly wet lower stems, including root collar area, but not to the point of runoff. Vary herbicide concentrations with size and susceptibility of species treated. Apply at any time from January to November except when snow or water prevents spraying to the ground line. Avoid treating when bark is soaking wet with water.

THIN-LINE BASAL BARK TREATMENT

To control susceptible woody plants with stem diameters less than 6 inches, apply undiluted triclopyr ester product in a thin stream to all sides of lower stems as allowed on the label. Direct the stream horizontally to apply a narrow band of herbicide around each stem or clump. Up to 0.5 oz of chemical will be needed to treat single stems, and from 1 to 3 oz to treat clumps of stems. Use an applicator metered or calibrated to deliver the small amounts required. A D2 nozzle gives the desired stream. This is effective on sprouts with smooth exposed bark.

Cut Surface Applications: Hack-and-Squirt, Stem Injection and Cut Stump Treatment

Individual trees or resprouting cut stumps can be treated using stem injection or a hack and squirt. In the hack-and-squirt method, the tree trunk is frilled or cut at intervals around the trunk using an axe or machete. Cut spacing can vary depending on the herbicide and dilution with water. A complete frill or girdle can be effective, but is labor intensive. Each herbicide used and species controlled will have different cut spacing ranging from 1 cut /1 inch of stem diameter to 1 cut/ 3 inches of stem diameter (see table: Herbicide Recommendations for Control of Listed Species). Cuts must be through the bark and into the sapwood; chips remain connected to the tree to form a small cup or frill. The cut should be treated with concentrated salt-formulated herbicide solution immediately after the frill is made. Few species require complete frilling. Spaced axe cuts treated with 0.25 tsp (one milliliter (ml) or cubic centimeter) of water-soluble herbicide solution per cut are usually adequate. Special injector hatchets and stem injectors are available to make the cut and inject the herbicide at the same time.

Season can be important in cut-surface applications. Certain herbicides, including 2,4-D or triclopyr salts, are most effective during the early summer. Picloram, glyphosate, and imazapyr, are most effective when applied from midsummer to leaf fall. Rising sap in late winter/spring dilutes the herbicide and may prevent movement to the roots resulting in variable performance.

Cut stumps may be treated using either of two methods. One method uses the same herbicide in oil as for basal treatment. Research with bigleaf maple and Oregon white oak show results are best if the stump is thoroughly treated with a basal spray solution (triclopyr ester in oil) around the ground line and the cut perimeter any time after cutting, but preferably before it resprouts.

The second method for stump treatment is far less costly. Apply concentrated or diluted water-soluble herbicides (imazapyr, glyphosate or the salt form of triclopyr) to only the cambium perimeter (one inch of wood just inside the bark) of the freshly cut stump surface and any exposed cambium where bark may have been ripped or damaged down the side. A tablespoonful is adequate for almost any stump less than 1 ft in diameter when uniformly distributed in a thin line around the perimeter of the live wood. More is required for stumps over 12 inches in diameter. Treated stumps may sprout weakly the second year if treated during the growing season or fall. Spring stump treatment is not as successful. Try to cut and treat stumps within 1 hour as the cut surface will tend to suberize and not effectively absorb herbicide. Triclopyr ester undiluted can be used as an alternate treatment on stumps that have dried out or where a significant delay has occurred.

Herbicides Imazapyr, glyphosate, triclopyr salts, or picloram, used singly or in combination, are most effective and easiest to apply using the hack and squirt method. Esters do not work as well, except for triclopyr ester when applied to stumps cut 1 to 30 days after cutting. Most herbicides can be used diluted with water, and some products allow using the undiluted material. A dilution of 50% by volume in water works well for most herbicides. Be sure to check the label on maximum concentrations and rates. For products allowing undiluted applications users can save on carrying material but also this requires more precise application to meter out very small volumes per cut. On hardwoods other than maples, triclopyr salt formulations may be diluted to half strength with water. Triclopyr is very effective on many species. Imazapyr is highly effective on maples and on almost all other hardwoods, and may be diluted without losing effectiveness on most species. A dilution of 50% v/v in water gives excellent control of maples and other associated spe-

cies. Glyphosate may be used at half to full strength and is effective on most hardwood species except bigleaf maple. 2,4-D amine is effective on alder, cherry, and madrone when used at full strength. Be sure to check labels for current correct dilutions on the product being used.

Application For stem injection or hack and squirt, use one milliliter (ml) of the diluted solution for each cut. Use glyphosate during summer and fall for best results with cut spacings of one per inch of diameter. Use picloram in any of these seasons in mixture with 2,4-D, but control will be best if picloram is applied in summer. Triclopyr is effective in spring, fall, and winter if trees are completely frilled. In summer, space cuts for triclopyr about 3 inches between centers, or about one cut per inch of diameter. Imazapyr is effective all year but best performance is from mid-summer into winter while spring applications can be more variable. Imazapyr cut spacing can be 6 inches (about one cut per two inches of diameter) on trees up to 12 inches in diameter, and 3 inches on larger maples; use the more concentrated material in winter.

Application may be made with various types of tree injectors, or with a hatchet and squeeze/spray bottle. Tree injectors are tools designed to place chemicals into trees without frilling, girdling, or felling. The objective is to inject the chemical directly into the live tissue of the tree. Injector hatchets permit reaching around trees from one side, and should make this a very useful and low-cost method, particularly since modern chemicals do not require injection at the base of the tree.

The hack-and-squirt method is slower than the injector method, and is less precise in metering chemicals. Animal health syringes attached by tubing to small reservoirs that can be adjusted to 1 ml increments have shown usefulness. The method offers the advantage of a lower investment cost for small jobs.

Injecting/frilling conifers is probably the cheapest way to thin stands of fewer than 1,000 conifer trees per acre. Total kill is not required, and minimal dosages permit good development of untreated trees. Heavy dosages, particularly of picloram and imazapyr, offer danger of flashback damage to untreated trees whereas glyphosate involves less risk.

Hazards

All methods of forest weeding entail some risks. Some are measurable, such as frequency of accidents. Scientists can evaluate exposure—and to some extent, actual intake—of pesticides, exhaust fumes, fuels, and lubricants—and observe whether worker safety is affected. Evidence to date suggests physical injury while working in the woods is where greatest improvements in safety can be made, primarily related to falls, falling trees, bee stings, and chainsaw accidents.

Pesticide applicators must consider numerous factors. Treating a forest often entails applying herbicides over large areas. Definitions of treatment boundaries and stream buffers must be very clear. It is always wise for the applicator to avoid unnecessary exposure to all risks, including potentially harmful machines, tools, and chemicals, including fuels and lubricants. It is always wise to consult neighboring landowners before a major spray job, and to take the needed precautions to avoid chemical trespass. The benefits from judicious and well-planned herbicide use can be enormous and should not be jeopardized through poor public relations or careless application.

Restricted-use pesticides Atrazine and picloram (except in the products Pathway and Tordon RTU) are federally restricted-use herbicides. Both are low in mammalian toxicity but require special handling because of potential for water contamination and, in the case of picloram, high crop sensitivity. A certified applicator's license is required for purchase and use of restricted-use products.

Besides federally restricted-use products, some forestry labeled products can have restricted uses in an individual state. A list of ingredients that have restricted uses in the Pacific Northwest are located in the beginning of this handbook. Users should consult the label and the respective state department of agriculture for additional restrictions.

Always follow directions on the herbicide label. The label is legally binding. The information in this handbook is not intended to be a complete guide to herbicide use. Before using any herbicide, read the label recommendations on the container. Before an herbicide can be recommended for a specific use, it must be thoroughly tested. Recommendations on the manufacturer's label, when followed, can prevent many problems arising from the wrong use of a chemical. Because some uses listed on labels are marginally cost effective, they often are not discussed here, although they are legal. Herbicide distributors are legally obligated to provide accurate information about their products, and the information they provide on interpretation of labels is legally binding. If you are uncertain about label interpretation, your dealer can help, or consult with your state department of agriculture for final determination.

Special Considerations

Competition from brush is only part of the brush problem in areas due for reforestation. Brush is fine habitat for animals that feed on tree seedlings. Moreover, in heavy stands of brush, dead or alive, substantial shade will weaken trees and considerable debris can fall and crush small seedlings. It is always best to provide for reforestation before brush becomes well established, and to avoid suppressing conifers by controlling fast-growing species such as alder and maple when they are in seedling or young sprout stages. If weeding is needed, it is always most effective if the planted trees are never exposed to competition. Site preparation is the most important step in avoiding the weed problem.

Two or more herbicide applications may be desirable for full plantation establishment. Schedule them so that most woody competitor species are controlled the summer before planting (often better

before harvesting) with a site-preparation treatment. After planting, maintenance spray with a soil-residual material such as atrazine or hexazinone prolongs brush relief with minimum damage to conifers (see “Recommendations for Grass and Forbs in Plantation Establishment” in this section). Never postpone release until trees are under the brush.

Some commonly used herbicides are injurious to conifers at high doses or during the growing season. Control difficult weed problems before planting, as part of site preparation. Both Imazapyr and sulfometuron near the maximum label rate can be injurious, even when used as directed. Use maximum rates only in exceptional circumstances. The potential exists for stunting injury when imazapyr is applied broadcast over labeled western Oregon conifers at more than 3 oz ai/a.

Several precautions will minimize damage from foliage-active products when used for conifer release.

- 1) Adding surfactants to any herbicide used for broadcast release can increase the risk of conifer damage.
- 2) Using maximum registered rates of foliage-active products for conifer release often produces symptoms of injury in conifers, so use these rates only when attempting to control hard-to-kill species and when some conifer injury is tolerable.
- 3) When applying foliage-active herbicides with ground equipment, do not spray directly into desirable seedlings and saplings because doing so causes “hot-spots” of heavy application that can result in injury and even mortality.

Special Registrations for Forestry

Herbicides should carry specific recommendations for a particular use on their labels. Forests are not included under non-crop labeling, according to recent interpretations of labeling laws. Some products are registered for site preparation only, and some for more general use, including conifer release. Some products have no forestry uses on the product label but are available for use through a special local needs label (SLN supplemental label or 24c) in the appropriate state. These are separate labels and can be obtained from the manufacturer or distribution channel and must be in possession during product use. Contact your supplier for these labels, or consult the department of agriculture when legality of a label is in doubt.

Herbicide dealers and distributors are required under the Federal Pesticide Control Act of 1972 to ensure that their products are properly labeled and sold only for purposes described on the label. The major herbicides registered for forestry use are listed in the tables that follow, and in recommendations for “Grass and Herb Control for Plantation Establishment” in this chapter, with a rating of effectiveness on some important forest species.

Invasive Weeds in Forests

Invasive weeds have many opportunities to establish and spread in forests. Many of these species are exotic, but many native species also proliferate when given disturbed soils and protected environments. Landowners are urged to keep these pests under control, if only for the public good. Once such weeds are introduced, they are very costly to eradicate.

Many invasive species are woody plants that have been propagated and distributed commercially. English holly, English ivy, gorse, and Scotch broom have been planted as ornamentals and have escaped to cover large areas of pasture and cut-over forest lands. Himalayan and evergreen blackberries, brought by settlers into this region for their fruit, are popular for recreational picking and eating. Broom and gorse have lovely yellow flowers. All are highly invasive, have persistent seeds, and will occupy ground rapidly. Birds spread them by foraging on fruits and seeds. Deer and other wildlife carry seeds to provide new colonies. These species are equipped to survive many obstacles. Programs to eradicate them may appear successful in the short run but are likely to fail in the longer term. Control requires persistence and good recognition as well as understanding their means of survival and propagation. Establishing a conifer crop that can shade out these exotics is an important approach to managing this problem. For more detail, see “Section W. Control of Problem Weeds” in this handbook.

Some exotic plants are still sold in commercial nurseries. English holly and English ivy pose major long-term problems: they are very tolerant of shade, they flourish under dense second-growth stands, and they are difficult to kill with herbicides normally in a forester’s tool kit (see Section “Control of Problem Weeds” in this handbook for more information on ivy control). The key to successful management is early recognition and eradication before plants get big enough to produce seed or reproduce vegetatively. Ivy and holly produce seeds when growing in shade; hence seedlings must be removed before plants reach seed-bearing size. Ivy, which must climb into upper crowns to produce seeds, will develop crowns capable of shading out second-growth Douglas-fir. Holly can create dense stands from scattered understory seedlings, eventually leading to shade so dense hemlock trees cannot survive. These attractive plants are serious pests. Periodic inventories of forest stands will determine where problems are likely and where attention should be directed next. For example, holly seedlings are often found along

powerlines where birds tend to roost.

Many invasive plants are spread by machines, including logging equipment and various motor vehicles. One of the most important conduits for invasive plants is roads. Road graders, ditch cleaners, bulldozers, car tires, log trucks, and many other types of machinery that travel along roads pick up seeds and vegetative structures and move them to new areas. Maintaining weed-free road shoulders and backslopes is the only certain way to prevent spread. Some landowners require that all equipment brought in to do logging and road work be washed down before entering and leaving the property.

Weed control programs designed to maintain visibility along roads may help to reduce the spread of invasive species. They also provide unoccupied habitat where seeds, viable stem pieces, and whole plants have room to grow. Unless sources of contaminating plant material are kept under control, these species will spread through a road system and into clearcuts or otherwise disturbed areas. Use herbicide mixtures that favor the establishment of competitive cover such as low-flammability grasses while removing brush, and use native plants that are less likely to become weeds themselves. Low, dense vegetation beyond the road shoulders is a good way to minimize invaders.

Keep a road system relatively free from invasive plants by maintaining a section of road right-of-way as free as possible from invasive plants, long enough to prevent invasive plants from moving effectively. Control of vegetation on road shoulders with a broad-spectrum herbicide that inhibits germination or vegetative propagation can be effective if the general road system is relatively free from invasive plants. Patrol these roads two to three times each summer to recognize and control small invasions, and thus prevent their spread. Clean-up of small patches is far cheaper than clean-up of established exotic stands.

Many species, such as horseweed (maretail), spread very rapidly after fire or clear-cutting, especially if other weeds (i.e., cover that competes with the invasive species) are controlled with products with little soil residual in late spring. Horseweed germinates later than many weeds and also can develop herbicide resistance. Certain products (e.g., clopyralid and directed applications of aminopyralid), will control this weed, especially if applied in early summer. Aminopyralid is not selective over conifers.

Blackberries (Himalayan and evergreen species) are especially troublesome along rights-of-way where they spread across fences. Herbaceous species too numerous to mention are capable of colonizing new clearcuts and understories of thinned stands. Species such as *Brachypodium* (false brome), prickly lettuce, sweet cicely (a native or naturalized exotic), Roberts geranium, and many others will invade disturbed understory sites and exclude native herbs. Where wildlife species prefer native plants for forage, the invasive plants may degrade habitat by replacing native cover. One seldom knows the true cost of such invasions, yet the mixture of these invaders may be difficult to control economically until the site becomes occupied with desirable and dominant cover. Good site preparation and timely release often help minimize invasive species, but also may create openings for invasion if products with little residual activity are used.

The diversity of invasive plants almost guarantees failure to control all of them. Clearly, the best control is a dominant cover with a group of species that casts a dense shade. Douglas-fir and western red cedar are valuable species that cast dense shade from about ages 13 to 40 years in un-thinned stands. Western hemlock and grand fir may provide better shade than Douglas-fir and cedar, but tend to be lower in value. Regardless of the overstory species present, thinning

will offer new opportunities for invasive plants as well as increase the growth of the conifer crops. In controlling invasive species, it will be essential to follow thinning with a weed control program designed to avoid damaging overstory trees and desirable forage species. This technology is in its infancy.

Identification of potential invasive species is essential, so that appropriate and common controls can most effectively prevent their establishment. Many herbicides and herbicide combinations are registered for use in young stands, and each will control a certain spectrum of weeds, depending on dosage and time of application. The nature of disturbance in the logging operation also will influence the composition of invaders. Site history (i.e., whether broom, blackberries, gorse, or other plants with persistent seeds were present before the current stand was harvested) will provide warning of a seed bank not yet emerged. One problem that will become worse is treatment tolerance: some exotic species may have a certain percentage of plants that tolerate a given treatment, and over time these may become resistant. It is especially important to remove such resistant individuals before they spread across the landscape. This, however, requires surveillance beyond most of our capabilities, and this problem will require extensive attention.

Effectiveness of Major Forestry-registered Herbicides during Seasons of Optimum Usage, Oregon Basis

Species	atrazine (spring)	clopyralid (all)	glyphosate (late summer)	picloram (all)	2,4-D (spring, fall)	hexazinone (spring)	sulfometuron (fall)	metsulfuron (summer)	metsulfuron (fall)	triclopyr ester (spring)	imazapyr (late summer)
CONIFERS											
Douglas-fir	R	R	I-R	S	I-R	R	I-R	S	I	I-R	I
Firs, true	R	R	R	S	S-I	R	R	S		I	I
Hemlock	I-R	R	I-R	S	I-R	R	R	S		I	I
Pines	R	R	I-R	I-S	S-I	R	R	S		S	S-I
Red cedar, western	I-R	R	I	S	S	S	I-R	S	I-R	I	
WOODY SPECIES											
Alder			I	S	I-S	I-R	I-R	R	R	S	S
Blackberry			I	S	R	I	I-S	S	S	S	R
Cascara			S	I	I	R		I		S	I
<i>Ceanothus</i> spp.			I-R*		S	I		I		S	S
Cherry			S	S	S	R		S		I	S
Chinquapin			I-R*		I	R		I		S	S
Elderberry		S	S	S	R	R		S	R	S	S
Hazel			S	I	I	R				I	S
Madrone			I-R*	S	S	R		I		I	S
Manzanita (<i>Arctostaphylos</i> spp.)			R	S	S	R		I		I	R
Maple, bigleaf			I	I	R	R	R	R	R	I	S
Maple, vine			S	I-S	R	R	R	R	R	I-S	S
Poison-oak			S	S	R	R	R			I-S	S
Salmonberry			S	I	R	I	I	S	S	I	I
Snowberry			S		I-S			S	S	I	
Tanoak			R	S	I	R	R	I		I-S	I
Thimbleberry			S	I	I	I	I	S	S	I	I
Willow (<i>Salix</i> spp.)			S	I-S	R-S	R				I-S	S
HERBS											
Fern, bracken	I		I-S	I	R	I	S	S	S	R	
Fern, sword	R		I	R	R	R	I-S	S	S	R	
Grasses, annual	S		S	R	R	S	S	R	R	R	S
Grasses, perennial	S-R		S	R	R	S	S	R	R	R	S
Herbs, broadleaf	I	S**	S	S-I	S	S	S-R	S-R	I	I-S	S

R = resistant to highest rates I = intermediate or variable; highest rates effective S = sensitive; killed by medium or lower rates

* Glyphosate has intermediate activity if applied after full leaf expansion but before wax develops on leaves of evergreen species; it has marginal conifer selectivity in spring.

** Clopyralid has activity on selected broadleaf weeds such as Canada thistle and other thistles.

Recommendations for Directed Spot Spray, Tree Injection, and Basal Bark Treatment

Hand applications of herbicides can be very effective in controlling individual plants or small areas of weeds. The information below lists applications for directed foliage spraying using common herbicide products. Following this is a species specific table with information on foliage sprays, basal applications and cut surface stem treatments. Spot foliage treatments can use larger volumes of spray solution than broadcast sprays. The table assumes volumes applied at 50-100 gallons per acre. Users should always read the label of the products they are using to make sure they don't exceed any per acre maximum listed and adjust the herbicide concentration accordingly. When spraying around conifers or other desirable plants, avoid foliage contact especially during active growth.

Commonly Used Herbicides for Directed Foliage Applications

2,4-D ester (Weedone LV 4 or LV 6 and many others)

Rate 1 to 4 % product v/v in water)

Time Apply when broadleaved weeds are small in the spring for best results. For woody plants treat when they are active from spring through summer. Avoid contact with conifers especially when they are actively growing.

Remarks 2,4-D controls a large spectrum of broadleaved weeds and woody plants including thistles, false dandelion, woodland groundsel, sow thistle, alder, madrone, manzanita species and many others. Amine salt formulations can also be used, but ester products perform better in early spring and on woody species. For best herbaceous control apply in spring while plants are small. Addition of an oil or seed oil surfactant may improve control on evergreen brush species and some broadleaved weeds.

Caution Consult label to avoid exceeding maximum yearly and single application rate. Esters are volatile and vapors can move off target in hot weather potentially damaging conifers and desirable plants.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

clopyralid (Transline and others)

Rate 0.25 to 0.5 oz product per gallon of water to treat 1,000 sq ft (equivalent to 2/3 to 1 1/3 pints per acre)

Time Apply when plants are actively growing, but especially in the spring when susceptible weeds are present and developing.

Remarks Clopyralid controls a select group of herbaceous plants and elderberry on forest sites. For control of bull thistle and small woodland groundsel, use the lower rate early in the growing season. In late spring higher product rates may be needed to control larger plants. Canada thistle is best controlled at bud stage in late spring. Fall applications can be effective on certain species. Additional sensitive weeds include other thistles, clovers, hawkweeds, yellow starthistle, sow thistles, prickly lettuce, some knapweeds and vetches. Red elderberry is effectively controlled during the summer foliage season. Clopyralid can be an effective tank mix herbicide with 2,4-D for broad spectrum control on mixed broadleaved weeds in reforestation sites. Conifers, grasses and many other broadleaved weeds are tolerant.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

glyphosate (Rodeo, Roundup Custom and many others)

Rate 1 to 5 % product v/v in water

Time Apply as a directed spray on foliage of grasses and annual weeds any time they are green and growing. Perennial weeds like bracken fern and deciduous shrubs should be treated from mid-summer through fall before significant leaf fall. Avoid contact with desirable conifers and non-target plants.

Remarks Glyphosate can control a wide variety of deciduous shrubs such as salmonberry, thimbleberry, hazel, oceanspray, vine maple, cherry, elderberry, poison oak, and perennial forbs like bracken fern as a foliage spray.

There are many glyphosate products labeled for forestry use. Users should carefully read the product label they are using and make sure they do not exceed maximum labeled concentrations. Use the lower rates for grasses and weeds and higher concentrations for woody plants. Products that have no surfactant in the formulation may be safer spraying near conifers in case of accidental overspray, although additional surfactant may improve control.

Caution Douglas-fir and other conifers can be injured by glyphosate because of any overspray during directed spraying. They are most sensitive as buds swell and budbreak occurs in the spring through early summer. Apply around dormant seedlings to mitigate risk of injury.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

imazapyr 4 lb ai/gal (Arsenal Applicators Concentrate, Polaris AC Complete and others)

Rate 0.25 to 5 % product v/v in water.

Time Apply when brush plants and hardwoods are fully leaved out from mid-summer through leaf color in the fall avoiding conifer contact and over application near their roots.

Remarks A wide variety of deciduous shrubs and some evergreen plants are sensitive to imazapyr. Maples, hazel, ocean spray, cherries, oaks, cottonwood, willow, poison oak, madrone and chinkapin are sensitive. Recovering bigleaf maple sprout clumps (one to two years from cutting) are effectively controlled with a 2.5% solution from summer into fall. Applications should be made just to cover foliage but not to runoff. Although imazapyr has activity on many grasses and forbs, it is rarely used for those species in forestry in the Northwest.

Some product labels restrict applications for site preparation to sites that will be planted to certain conifer species (Douglas-fir, western hemlock, ponderosa pine, lodgepole pine, sugar pine and white pine) or around certain established conifers (Douglas-fir, lodgepole pine, white pine) for release. Users should carefully read product labels for labeled sites, conifer species and any maximum per acre rates. Some products containing 2 lb ai/gal

are available for forest management and are generally used at twice the rate as 4 lb ai products.

Caution Imazapyr has significant soil activity and high rates or over application can result in mortality or injury to conifers and non-target plants that have root systems extending into treated areas. Do not apply more than 1.5 lb ae per acre per year. Avoid contact with conifer foliage.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Imidazolinone

metsulfuron (Escort XP and others)

Rate 2 to 4 ounces product per 100 gallons of water.

Time Apply when brush plants and hardwoods are fully leafed out from summer through the fall but before leaf coloration. Avoid conifer foliage contact.

Remarks Metsulfuron controls a wide variety of deciduous shrubs and herbaceous plants prior to planting or in established plantations as a directed spray. Rubus species such as blackberries, salmonberry, thimbleberry, and blackcap are especially sensitive to metsulfuron and lower rates effectively control these. Other species controlled include snowberry, cottonwood, cherry, willow, oak, and oceanspray. A number of herbaceous weeds are controlled, but bracken fern and sword fern are the major forestry targets. Consult labels for additional weeds controlled.

Caution Metsulfuron can be damaging to conifers and users should avoid contact with conifer foliage if they are present.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

triclopyr ester (Garlon 4 Ultra, Garlon 4, Triclopyr 4)

Rate 1 to 5% product v/v in water.

Time Apply when deciduous brush plants and hardwoods are fully leafed out from summer through the fall but before leaf coloration. Treat evergreen plants from spring into summer. Avoid contact with conifer foliage especially during active growth.

Remarks Triclopyr ester controls a wide variety of deciduous and evergreen shrubs as well as herbaceous plants prior to planting or in established plantations as a directed spray. Species such as blackberries, poison oak, Scotch broom, gorse, snowbrush ceanothus, madrone, tanoak, and myrtle are especially sensitive to triclopyr. For blackberries treat in late summer into late fall for best control at lowest rates (1 %). Scotch broom, gorse and many evergreen brush species can be effectively controlled from spring and early summer applications at a 2% concentration along with oil type surfactants. Other species controlled include cottonwood, alder, cherry, willow, and oak. A number of broadleaved herbaceous weeds are controlled but these uses are not generally used in the Northwest on forest sites. Consult labels for additional weeds controlled.

Caution Avoid contact with conifer foliage, especially ponderosa pine. Triclopyr ester is volatile and vapors can move off site during warm temperatures and damage conifers or other desirable plants. Products containing triclopyr salts are less volatile and have less risk of off-site movement but control of some species may be reduced.

Site of action Group 4 synthetic auxin

Chemical family Pyridine

Herbicide Recommendations for Control of Listed Species

Species	Herbicide ¹	Active ingredient per 50-100 gal of solution	Carrier	Expected control	Application and remarks
Alder, red <i>Alnus rubra</i>	2,4-D	3 lb	Water	Excellent	Foliage spray. See label for release timing.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Excellent	Foliage spray. Site prep only.
	2,4-D amine	Undiluted	None	Good	Injection, 3 inches between centers, 1-2 ml/injection.
	picloram + 2,4-D	Undiluted	None	Good	Injection, 3 inches between centers.
	triclopyr ester	3 lb	Water	Good	Midsummer directed foliage spray.
	triclopyr salt	50%	Water	Excellent	Injection, 3-4 inches between centers. Use full strength in maple and tanoak.
	triclopyr ester	2 to 15% product in oil	Oil	Excellent	Low-volume basal treatment.
	glyphosate	3 lb ae	Water	Good to excellent	Foliage spray. Summer.
	imazapyr	25-50%	Water	Excellent	Trunk injections, 6 inches between centers.
		10 lb (2.5%)	Water	Excellent	Low-volume sprays June-Aug. on sprout clumps.
Ash, Oregon <i>Fraxinus latifolia</i>	triclopyr salt	3 lb	Water	Excellent	Foliage spray.
	triclopyr ester	3 lb	Water	Excellent	Directed foliage spray.
Birch <i>Betula</i> spp.	glyphosate	3 lb ae	Water	Good	Directed foliage spray; summer to fall. Adding imazapyr may improve control.

Species	Herbicide ¹	Active ingredient per 50-100 gal of solution	Carrier	Expected control	Application and remarks	
Blackberry	glyphosate	3 lb ae	Water	Good	Sept.-Oct., as long as most foliage is still green.	
	metsulfuron	2 oz	Water	Excellent	Spring, summer, fall site prep.	
Himalayan <i>Rubus procerus</i>	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Aug.-Sept. Site prep only.	
	triclopyr ester	3 lb	Water	Excellent	Directed foliage spray; midsummer to fall. Use directed spray around pines.	
Evergreen <i>R. laciniatus</i>	triclopyr salt	2 to 3 lb	Water	Excellent	Foliage spray; midsummer to fall. Use directed spray around pines.	
Trailing <i>R. vitifolius</i>	aminopyralid + triclopyr amine (Capstone)	0.075 to 0.11 + 0.75 to 1.12 lb (6 to 9 pints product/a)	Water	Good to excellent	Midsummer to fall foliage spray	
All <i>Rubus</i> spp.	metsulfuron	2 oz	Water	Excellent	June–Sept. Kills conifers.	
Broom, Scotch <i>Cytisus scoparius</i>	2,4-D	2 lb	Water-oil emulsion	Excellent	March. See label for release timing.	
	triclopyr ester	2 to 15% product in oil	Oil	Excellent	Basal spray Feb. to Oct.	
	triclopyr ester	2 to 4 lb	Water	Excellent	Foliage spray Feb. to Oct. Oil or oil surfactants may improve control.	
	aminopyralid + triclopyr amine (Capstone)	0.075 to 0.11 + 0.75 to 1.12 lb (6-9 pints product/a)	Water	Good to excellent	Foliage spray. Optimum at bud to bloom.	
Cascara, buckthorn <i>Rhamnus purshiana</i>	glyphosate	3 to 4 lb ae	Water	Good	Midsummer to late summer.	
<i>Ceanothus</i> spp.*	triclopyr ester	3 lb	Water	Good to excellent	Midsummer directed foliage spray.	
Mountain whitehorn <i>C. cordulatus</i>	imazapyr	1 lb	Water	Good to excellent	Midsummer directed foliage spray.	
Blue blossom <i>C. thyriflorus</i>	2,4-D	2 lb	Water	Excellent	Foliage spray. See label for release timing.	
	glyphosate	3 lb ae	Water	Excellent	Sept., foliage spray. Deerbrush or Redstem only.	
Snowbrush <i>C. velutinus</i>	aminopyralid + triclopyr amine (Capstone)	0.075 to 0.11 + 0.75 to 1.12 lb (6-9 pints product/a)	Water	Good	Foliage spray.	
Deerbrush <i>C. integerrimus</i>						
Redstem <i>C. sanguineus</i>						
Cherry, bitter <i>Prunus emarginata</i>	picloram + 2,4-D	1 gal (0.54 to 2 lb ae)	Water	Good to excellent	Foliage spray. Site prep only.	
	glyphosate	3 lb ae	Water	Excellent	Summer foliage spray. Imazapyr additions may improve control	
	triclopyr ester	2 to 15% product in oil	Oil	Excellent	Basal spray.	
	Chokecherry <i>P. virginiana</i>	triclopyr ester	undiluted	None	Excellent	Thin-line basal bark treatment.
		metsulfuron	2 oz	Water	Excellent	June foliage spray.
		2,4-D amine	undiluted	None	Excellent	Injection, stump treatment, or frill June–Aug.
		imazapyr	25-50%	Water	Excellent	Injection or frill June- December
Chinquapin <i>Castanopsis</i> spp.	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Site prep only.	
	2,4-D amine	undiluted	None	Good	Frill treatment.	
	triclopyr ester	4 lb	Water	Excellent	Foliage spray. Directed spray.	
		2 to 15% product in oil	Oil	Excellent	Basal spray.	
	imazapyr	25-50%	Water	Excellent	Injection or frill June-December	
Coffeeberry <i>Rhamnus californica</i>	2,4-D	4 lb	Water**	Poor	Directed foliage spray or site prep	
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Site prep only.	

Species	Herbicide ¹	Active ingredient per 50-100 gal of solution	Carrier	Expected control	Application and remarks
Cottonwood <i>Populus trichocarpa</i>	2,4-D amine	undiluted	None	Good	Frill treatment or injection.
	triclopyr ester	2 to 15% product in oil	Oil	Excellent	Basal spray.
	glyphosate	3 lb ae	Water	Excellent	Foliage spray, July–Aug. Not recommended in Idaho.
	metsulfuron	2 oz	Water	Excellent	Full foliar.
Currant and Gooseberry <i>Ribes</i> spp.	2,4-D + picloram	1 gal	Water	Good	Summer.
	glyphosate	3 lb ae	Water	Poor	Summer–fall.
Douglas-fir <i>Pseudotsuga menziesii</i>	picloram + 2,4-D	2 gal (1.08 + 4 lb ae)	Water	Good	Roadside spray.
	glyphosate	50%	Water	Excellent	injection or frill, summer to winter.
	picloram + 2,4-D	undiluted	None	Excellent	Injection (thinning) fall-winter.
	metsulfuron	2.4 oz	Water	Poor to excellent	Full foliage spray, spring to summer.
Elderberry, red <i>Sambucus callicarpa</i>	clopyralid	6 oz	Water	Excellent	Foliage spray, summer-fall
	glyphosate	3 lb ae	Water	Excellent	July–Sept.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Excellent	Foliage spray, summer.
	triclopyr ester	3 lb	Water	Excellent	June–July.
Gorse <i>Ulex europaeus</i>	picloram + 2,4-D	1 gal (0.54 + 2 lb)	Water	Excellent	Foliage spray. Best on younger plants. Site prep only.
	triclopyr ester	4 to 8 lb ae	Water	Excellent	Spring.
	metsulfuron	2 oz + surfactant	Water	Excellent	Spring.
Hazel <i>Corylus cornuta</i> var. <i>californica</i>	glyphosate	3 lb ae	Water	Excellent	Late summer foliage spray. Adding imazapyr may improve control.
	triclopyr ester	2 to 15% product in oil	Oil	Excellent	Basal spray.
Madrone <i>Arbutus menziesii</i>	2,4-D ester	4 lb	Water	Good	Directed foliage spray/site prep, spring/summer.
	2,4-D amine	undiluted	None	Excellent	Injection, 1–2 ml/inch of diameter
	triclopyr ester	2 to 3 lb	Water	Fair	Midsummer directed foliage spray.
		2 to 15% product in oil	Oil	Excellent	Basal spray.
	imazapyr	25% strength	Water	Excellent	Injection, 6–9 inches between centers.
	glyphosate	50% to full strength	Water	Excellent	Cut stump/injection.
Manzanita spp.* Hairy <i>Arctostaphylos columbiana</i>	triclopyr ester	2 to 3 lb	Water	Poor to fair	Midsummer directed foliage spray. Not recommended in Idaho.
		2 to 15% product in oil	Oil	Excellent	Basal spray
Hoary <i>A. canescens</i>	2,4-D	2 lb	Water	Good	Foliage spray. See label for release timing.
Pine <i>A. parryana</i>					
Whiteleaf <i>A. viscida</i>					
Greenleaf <i>A. patula</i>					
Howell's <i>A. hispidula</i>					

Species	Herbicide ¹	Active ingredient per 50-100 gal of solution	Carrier	Expected control	Application and remarks
Maple* Bigleaf <i>Acer macrophyllum</i> Vine <i>A. circinatum</i> Rocky Mountain <i>A. glabrum</i>	imazapyr (4 lb/gal)	25% to 50%	Water	Excellent	Injection summer-fall.
		10 lb (2.5%)	Water	Excellent	Foliage spray on sprout clumps. Very low volume.
	triclopyr salt	undiluted to 50%	Water	Excellent	Injection, half-strength for trees less than 12 inches or for stump treatment.
	triclopyr ester	4 lb	Water	Fair	Foliage spray of sprout clumps. Not for conifer release.
	triclopyr ester	2 to 15% product in oil	Oil	Good to excellent	Basal treatment.
		undiluted to 50%	None/Oil	Good to excellent	Thin-line basal bark treatment.
		30% strength	Oil	Good to excellent	Low-volume basal bark treatment.
	picloram + 2,4-D	undiluted	None	Excellent	Frill, injection, or stump.
glyphosate	3 lb ae	Water	Good	Foliage spray, late summer.	
picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Site prep only.	
Ninebark <i>Physocarpus</i> spp.	glyphosate	3 lb ae	Water	Excellent	Summer and fall foliage spray
Oak Oregon <i>Quercus garryana</i> California black <i>Q. kelloggii</i> Canyon live <i>Q. chrysolepis</i>	glyphosate	3 lb ae	Water	Excellent	Foliage spray.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Excellent	Foliage spray. Site prep only.
	2,4-D amine or glyphosate	undiluted	None	Excellent	Frill; good on all oaks.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray. Good on all oaks.
		2 to 15%	Oil	Excellent	Basal treatment. Good on all oaks.
	imazapyr	25% strength	Water	Excellent	Cut surface or injection, 6 inches between centers.
	metsulfuron	2 oz	Water	Excellent	Full foliar.
2,4-D	24 lb	Water**	Good	Directed foliage spray or site prep, May-July. May be necessary to re-treat.	
Ocean spray <i>Holodiscus discolor</i>	glyphosate	3 lb ae	Water	Good	Fall foliage spray. Adding imazapyr may improve control.
Pine Lodgepole <i>Pinus contorta</i> Ponderosa <i>P. ponderosa</i>	triclopyr salt	3 lb-	None	Good	Injection; one cut per 3-inch circumference. May-Sept.
	metsulfuron	0.6 oz + silicon surfactant	Water	Good	Spring, after budbreak.
	triclopyr ester or 2,4-D ester	4 lb	Water/ Oil	Excellent	Foliage spray April-June.
Poison-oak <i>Toxicodendron diversilobum</i>	triclopyr ester	2 to 3 lb	Water	Good to excellent	Directed foliage spray. Spring application best.
	glyphosate	6 lb ae	Water	Excellent	Foliage spray July-Aug. (before color).
	2,4-D	4 lb	Water	Fair to poor	Directed foliage spray or site prep. Re-treat sprouts.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Fair	Foliage spray. Site prep only.
	imazapyr	4 lb	Water	Excellent	Directed spray in summer. Over application can injure nearby trees and plants through root uptake.
	aminopyralid + triclopyr amine (Capstone)	0.075 to 0.11 + 0.75 to 1.12 lb (6 to 9 pints product/a)	Water	Good	Foliage spray. Spring application best.
Rhododendron <i>Rhododendron macrophyllum</i>	imazapyr	10 lb (2.5%)	water	good	Directed Summer foliage spray
	triclopyr ester	4 lb	Water/ Oil	Fair to good	Spring foliage spray.

Species	Herbicide ¹	Active ingredient per 50-100 gal of solution	Carrier	Expected control	Application and remarks
Salal <i>Gaultheria shallon</i>	triclopyr ester	4 lb	Water	Fair to good	Summer foliage spray. Site prep only.
	picloram	2 lb	Water	Good	Summer foliage spray. Site prep only.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Fair	Foliage spray. Site prep only.
	imazapyr	10 lb (2.5%)	Water	Good	Low volume.
Salmonberry <i>Rubus spectabilis</i>	glyphosate	3 lb ae	Water	Excellent	July–Sept.; Sept. only for release.
	metsulfuron	1 oz	Water	Excellent	June–July. Injures conifers.
	sulfometuron	1.5 to 3 oz	Water	Good	April–May.
Serviceberry <i>Amelanchier</i> spp.	2,4-D	2 lb	Water**	Poor to fair	Foliage spray. Several treatments required. See label for release timing.
	glyphosate	3 lb ae	Water	Good	Summer–fall.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
Snowberry <i>Symphoricarpos albus</i>	glyphosate	4 lb ae	Water	Good	Foliage spray July–Sept. Not recommended in Idaho.
	metsulfuron	2 oz	Water	Excellent	Full foliar.
	triclopyr ester	2 to 3 lb	Water	Fair	Foliage spray.
Sweetbriar rose <i>Rosa eglanteria</i>	picloram + 2,4-D	1 gal (0.5 + 2 lb ae)	Water	Good	Good initial kill, some re-treatment on sprouts. Site prep only.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
	glyphosate	3 lb ae	Water	Good	Directed foliage spray.
Tanoak* <i>Lithocarpus densiflora</i>	2,4-D	4 lb		Poor	Directed foliage spray. Several treatments needed.
	imazapyr	50%	Water	excellent	Injection or frill, 6 inches between centers.
	triclopyr salt	Undiluted	—	Excellent	Injection any season, 4 in between centers.
	triclopyr ester	8 to 12 lb	Water	Good	Directed foliage spray
	triclopyr ester	2 to 15% product in oil	Oil	Good to excellent	Basal treatment. Best to treat third-year sprouts.
Thimbleberry <i>Rubus parviflorus</i>	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Re-treatment may be required. Site prep only.
	glyphosate	3 lb ae	Water	Excellent	Foliage spray, July–Sept.
	metsulfuron	2 oz	Water	Excellent	Full foliar.
Willow <i>Salix</i> spp. Note Oregon's many species of willow vary in susceptibility. These are starting recommendations.	2,4-D	2 lb	Water	Good	Foliage spray. May need to retreat sprouts. See label for release timing.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
	triclopyr ester	2-15% product in oil	Oil	Good	Basal treatment.
	glyphosate	3 lb ae	Water	Fair to good	Foliage spray July–Sept.
	metsulfuron	2 oz	Water	Excellent	Full foliar.
	imazapyr + glyphosate	0.5 lb ae + 3 lb ae	Water	Good to excellent	Foliage spray July–Sept.

*Based on results in southwestern Oregon.

**Adding 2 to 5% oil as an emulsion gives best results.

¹ Herbicides listed in these recommendations generally have broadly inclusive labels, in terms of effectiveness at concentrations given. New regulations regarding use and current label coverage should be consulted before using a particular product.

Broadcast Spraying Using Ground Equipment or Aircraft

Several products containing recommended active ingredients may be available for application with boomless ground equipment or aircraft. Before you buy, be sure that proposed uses comply with label restrictions. This is especially true for chemicals used specifically for growing tree crops.

In most cases, it is preferable to spray 2,4-D or triclopyr with aircraft late in the dormant season to avoid injuring Douglas-fir, hemlock, or true firs. Glyphosate and/or imazapyr are effective and selective in later summer, after conifer buds have hardened. Pines are very sensitive to 2,4-D or triclopyr between March and early July. In most situations, helicopter and broadcast ground applications with coarse sprays (VMD 1,000 microns or less) drift less and are as effective as finer sprays. Boomless nozzles cannot project fine drops to the edges of their swaths. They are best suited for soil-residual products and those with good systemic activity if applied in large drops, for example, hexazinone, glyphosate, and imazapyr.

Recommendations for Broadcast Spraying For Control of Listed Species

This table lists herbicide rates for site preparation and conifer release. In most instances release rates are for Douglas-fir before bud break in spring or after bud set in the fall. Users should check tolerance of other conifer species in the table “Effectiveness of Major Forestry-registered Herbicides” earlier in this chapter and the product label.

Species	Herbicide	Active chemical/a	Carrier	Expected control	Application and remarks
Alder, red <i>Alnus rubra</i>	2,4-D ester	2 lb ae	Water	Good	Release during early foliar timing. Best on trees under 10 yr. old.
		2 lb ae	Oil	Good	Dormant spray before conifer bud break, April and early May.
	picloram + 2,4-D	0.5 lb + 2 lb ae	Water	Good	Foliage spray. Badly injures conifers. Site prep only.
	glyphosate	0.75 to 1.5 lb ae	Water	Good	Release in Sept. Best on trees under 10 ft tall.
	glyphosate	2.25 to 3 lb ae	Water	Good	Site prep July-August
	triclopyr amine	3 to 6 lb ae	Water	Good	Midsummer foliage spray. Site prep only at this time.
	triclopyr ester	1.25 ae	Oil/Water	Good	Severely injures pines. Release. Use oil for dormant treatment. Use water only for early foliar treatments. See label for higher rates for site prep.
Birch <i>Betula</i> spp.	glyphosate and imazapyr	2 lb + .25 ae	Water	Good	Site prep summer- fall
Blackberry	triclopyr ester	1.0 lb ae	Water	Excellent	Fall release.
Bracken Fern	metsulfuron	.6 to 1.2 oz ai	Water	Excellent	Summer-fall site prep.
	glyphosate	1.1 to 1.5 lb	Water	Good	Fall release.
Broom, Scotch <i>Cytisus scoparius</i>	2,4-D ester	2 lb ae	Water + 5% oil	Good	Early spring release spray. Will reproduce from seed; some sprouting.
	2,4-D ester	2 lb ae	Oil	Good	Feb.-March dormant spray. Will reproduce from seed; little sprouting.
	picloram + 2,4-D	0.5 lb + 1 to 1.5 lb ae	Water	Good	Site prep only; summer to fall.
	triclopyr ester	1.25 lb ae	Water	Good to excellent	Douglas-fir release, spring
	aminopyralid + metsulfuron (Opensight)	0.11 ae + 0.31 ai (3.3 oz product/a)	Water	Good	Site prep only or directed spray. Manages germinants. Planting sooner than 4 months may injure conifers.
	aminopyralid + triclopyr amine (Capstone)	0.075 to 0.11 + 0.75 to 1.12 lb ae (6 to 9 pints product/a)	Water	Good to Excellent	Site prep only or directed spray. Keep spray from contacting trees.

Species	Herbicide	Active chemical/a	Carrier	Expected control	Application and remarks
Ceanothus spp., evergreen	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Foliage spray. Site prep only.
	triclopyr ester	1.25 to 1.5 lb ae	Water/oil	Fair to excellent	Release. See label for rates above 1.5 lb and for timing for dormant applications. Do not use on pines.
	2,4-D ester	2 to 2.75 lb ae	Water	Fair to excellent	Early foliar release. 2,4-D rates above 2 lb may injure some conifers.
	2,4-D + triclopyr ester	2 lb + 1 lb ae	Water	Good to excellent	Can control some associated species; spring, late summer. See label for timing. Do not use on pines. Good conifer release treatment in spring.
	fluroxypyr	7.7 oz ae	Water	Excellent	Site prep for pine only. Reduced rates suitable for release.
<i>Ceanothus</i> spp., deciduous	glyphosate	1.1 lb ae	water	Good to Excellent	For deerbrush and redstem. Fall release rate for Douglas-fir and other conifers
Cherry, bitter <i>Prunus emarginata</i>	imazapyr + glyphosate	.25 to .4 + 1.5 to 2 lb ae	Water	Excellent	Site prep only.
Elderberry <i>Sambucus</i> spp.	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Excellent	Foliage spray. Site prep only.
	glyphosate	0.75 to 1.1 lb ae	Water	Excellent	Sept. foliage release spray. Higher rate for site prep. Add 2 to 2.5 oz/a imazapyr to broaden spectrum.
	triclopyr ester	1.25 lb ae	Water	Good to excellent	Site prep. See label for application timing. Do not use on pines.
	clopyralid	4 to 5 oz ae	Water	Good to excellent	Use when plants are actively growing. June - September release.
Gorse <i>Ulex europaeus</i>	picloram + 2,4-D	2 gal (1.08 + 4 lb ae)	Water	Good	Good enough control for reforestation but not for eradication. Site prep only.
	metsulfuron	2 oz ai	Water + 0.15% silicon-based surfactant	Excellent	New Zealand data. Site prep only. Wait at least 6 mo before planting.
	triclopyr ester	1 to 1.5 lb ae	Water	Excellent	Spring release.
Madrone <i>Arbutus</i> spp.	2,4-D ester	2.75 lb ae	Water	Good to excellent	Associated species may be difficult to control. Rates above 2 lb (1 lb 2,4-D for pines) may injure conifers. Spring treatment best.
	triclopyr ester	1.25 lb ae	Water	Fair to excellent	Use lower rate before conifer bud swell for release. Do not use over 2- or 3-needle pines.
	picloram + triclopyr ester	1 lb + 1 to 2 lb ae	Water	Good to excellent	Site prep only. Not recommended in ID.
	triclopyr ester + 2,4-D	1 lb + 2 lb ae	Water	Good to excellent	Early summer before conifer budbreak. Can control some associated species. Do not use on pines.
	fluroxypyr	7.7 oz ae	Water	Excellent	Pine plantations only; use highest rates only for site prep.
Manzanita <i>Arctostaphylos</i> spp.	2,4-D	2 lb ae	Water	Good	Release. See label for timing.
	triclopyr ester	1.25 lb ae	Water	Poor	Early foliage spray release. Erratic. See label for timing. Do not use over pines.
	fluroxypyr	7.7 oz ae		Good	Highest rates for site prep only. Should be safe at reduced rates on pine plantations.

Species	Herbicide	Active chemical/a	Carrier	Expected control	Application and remarks
Maple	imazapyr	0.25 lb ae	Water	Good	Release late summer. May injure conifers.
	imazapyr	0.25 to 0.5 lb ae	Water	Good to excellent	Site prep summer. Add glyphosate to broaden spectrum.
	glyphosate	0.75 to 1.5 lb ae	Water	Fair to good	Sept. foliar release for vine maple. Adding imazapyr will improve control but may injure conifers.
Bigleaf <i>Acer macrophyllum</i>	glyphosate	2 to 3 lb ae	Water	Good	Summer–fall site prep
	imazapyr	0.25 lb ae	Water	Good to Excellent	Sept. release. May injure conifers.
Vine <i>A. circinatum</i>	glyphosate + imazapyr	0.75 to 1.5lb ae + 0.1 to 0.4 lb ae	Water	Excellent	Summer - fall site prep.
Rocky Mountain <i>A. glabrum</i>	picloram+ 2,4-D	2 gal (1.08 + 4 lb ae)	Water	Fair	Site prep only.
	triclopyr ester	1.25 to 1.5 lb ae	Oil	Excellent	Dormant spray, spring. Do not use on pines. Higher rate may injure Douglas-fir.
	picloram + triclopyr ester	1 lb + 1 to 2 lb ae	Water	Good to excellent	Site prep only, summer. Not recommended in Idaho.
Ninebark <i>Physocarpus</i> spp.	glyphosate	1.5 to 3 lb ae	Water	Excellent	Summer – fall site prep.
Poison-oak <i>Toxicodendron diversilobum</i>	imazapyr	0.2 lb/a	Water	Excellent	Apply in fall for release. Erratic, may injure conifers
	glyphosate	0.75 to 1.5 lb ae	Water	Excellent	Aug. -Sept. release. May be mixed with imazapyr but increases risk of conifer injury.
	aminopyralid + triclopyr amine (Capstone)	6 to 9 pints product (0.075 + 0.75 to 0.11 + 1.12 lb)	Water	Good	Site prep or directed spray only. Keep spray from contacting conifers.
Salmonberry <i>Rubus spectabilis</i>	picloram + 2,4-D	1 gal (0.54 + 2 lb ae)	Water	Good	Site prep only.
	glyphosate	0.75 to 1.1 lb ae	Water	Excellent	Aug.–Sept. release spray.
	metsulfuron	0.5 oz ai	Water	Excellent	Site prep.
Sword fern <i>Polystichum munitum</i>	metsulfuron	0.6 to 1.2 oz ai	Water	Good	Summer – fall site prep only.
Tanoak <i>Lithocarpus densiflora</i>	triclopyr ester	1.25 lb ae	Water/Oil	Good	Apply prebud swell for conifer release. Do not use on pines.
	2,4-D	2 to 2.75 lb ae	Water	Fair	Spring. Summer treatment may injure conifers after bud burst.
	picloram + triclopyr ester	1 lb + 1 to 2 lb ae	Water	Good	Site prep only, summer. Not recommended in Idaho.
Willow <i>Salix</i> spp.	2,4-D	2 lb ae	Water	Fair to good	Release. Retreatment of sprouts necessary. See label for release timing.
	glyphosate	0.75 to 1.5 lb ae	Water	Good	Release Aug-Sept.
	imazapyr + glyphosate	0.2 to 0.4 lb + 1.5 to 3 lb ae	Water	Excellent	Site prep only.

* 10% oil in carrier

Grass and Herb Control for Conifer Plantation Establishment

Planting conifers on fields or harvest units with heavy grass and weeds usually reduces plantation survival and growth. A moderately dense stand of grass in an open field in western Oregon can be expected to remove virtually all available moisture in the top 12 inches of soil by the end of June. Removing the grass and weeds gives seedlings much of the water that the grass would have transpired. Tillage may be used, but mechanized equipment must be able to negotiate the terrain. The advantage of herbicides is that a single treatment can give complete weed control during the first season and may give partial weed control in later seasons.

The method chosen should apply herbicide evenly for uniform weed control near planted seedlings. Many products can be applied over the top of existing conifer seedlings for release applications when done in a calibrated broadcast manner. Hand application equipment or aircraft such as helicopters are the only types of equipment suitable for application on rough terrain. Tractor-mounted sprayers equipped to spray a strip of herbicide down the plantation row have had some success on flat ground. When doing this, it is quite important that a wide enough strip be sprayed on each side of the planted row so that lateral roots do not draw down moisture supply too rapidly. In most situations, a strip at least 4 ft wide should be adequate for some habitat improvement for seedlings.

If spot spraying for release over the top of conifer seedlings, it is important to calibrate backpack sprayers and use flat fan type nozzles, such as a Spraying Systems 9502E. This will make a uniform swath, about 5 ft wide when held 4 ft from the ground. As you pass over a seedling, a quick on-off will create square patches with uniform dosage very quickly. Using a solid-cone nozzle in a circular motion around the tree risks overdosing in the center and possible conifer damage. Treating spots less than 3 ft in diameter has not generally proven very satisfactory. Large scale broadcast spraying with a backpack sprayer can be accomplished using a calibrated mini-boom set up with multiple nozzles or waving wand techniques with adjustable cone nozzles or off center nozzles like OC-12 or similar.

2,4-D ester (Weedone LV 4 or LV 6 and many others)

Rate 1 to 2 lb ae/a (33 to 66 oz/a LV 4 or 23 to 46 oz/a LV 6 product)

Time Apply preplant or post plant before conifer budbreak when susceptible plants are developing.

Remarks 2,4-D controls a large spectrum of broadleaved weeds and woody plants on forest sites including thistles, false dandelion, woodland groundsel, sow thistle, alder, manzanita species and many others. Amine salt formulations can also be used, but ester products perform better in early spring and on woody species. For best herbaceous control, apply in spring while plants are small and before conifers break bud. Douglas-fir, hemlock, and spruce are tolerant. True firs, redwood and cedars can show injury at high rates. Larch and ponderosa pine can show variable injury. 2,4-D can be a good foliar herbicide tank mix partner with atrazine or sulfometuron, depending on the conifers treated.

Caution Consult label to avoid exceeding maximum yearly and single application rate.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

ammonium nonanoate (Axxe)

Rate 6 to 15 percent in water v/v to make 30 to 125 gallons of spray solution per acre depending on weed height

Time Apply to target green foliage and vegetation any time on use sites.

Remarks Ammonium nonanoate is a nonselective contact burn-down herbicide that controls only green foliage and vegetation. Mature, taller or perennial vegetation requires higher concentrations and spray volumes than smaller succulent foliage. It provides no residual control and repeat applications to recovering foliage is necessary to maintain weed control. Complete coverage of foliage is needed for best results. Apply as a site preparation treatment or as a spot or directed spray to weed and grass foliage around conifer seedlings.

Caution Avoid overspray or spray drift onto conifer foliage, green stems or other non-target vegetation to reduce potential injury. Do not apply when rainfall is expected. Do not apply to wet foliage.

Site of action Organic herbicide; C9 saturated-chain fatty acid

Chemical family Unknown

atrazine (several trade names)

Rate 3 to 4 lb ai/a (3 to 4 quarts/a of liquid or 3.3 to 4.4 lb/a of 90% active product)

Time Apply preplant or postplant before conifer budbreak, when weeds are less than 1.5 inches tall.

Remarks Since atrazine is soil active and requires rainfall to activate it, apply in the spring on high rainfall sites or spring or fall on high elevation, high snowfall sites. Atrazine is best at controlling a wide variety of germinating grasses and broadleaf weeds when they are small. All conifer species appear tolerant to atrazine at labeled use rates. A foliar herbicide may be needed as a tank mix partner to achieve the best weed control such as clopyralid, 2,4-D, or glyphosate.

Caution **Restricted-use herbicide.** Applicators must be licensed to buy and apply atrazine. A closed system must be used for loading atrazine for aerial application at rates higher than 3 lb ai/a. Special buffer requirements exist for applications around certain streams in forests. Check label and state forestry regulations.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

clopyralid (Transline and others)

Rate 0.19 to 0.49 lb ae/a (8 to 21 oz/a product)

Time Apply any time of the year, but especially in the spring when susceptible weeds are present and developing.

Remarks All conifer species appear tolerant to clopyralid at any growth stage. For control of bull thistle and small woodland groundsel, use at least 8 oz/a product. In late spring higher product rates up to 21 oz/a may be needed to control larger plants. Canada thistle is best controlled at bud stage in late spring/early summer with rates at 16 oz/a product or higher. Additional sensitive weeds include other thistles, clovers, hawkweeds, yellow starthistle, vetches and elderberry species. Clopyralid can be an effective tank mix herbicide with soil active herbicides. Grasses and many other broadleaved weeds are tolerant.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

flazasulfuron (Mission)

Rate 0.033 to 0.045 lb ai/a (2.14 to 2.85 oz/a product) per application; no more than two per year at 2.85 oz or 9.6 oz total per year.

Time Apply pre-emergence to susceptible weeds or post-emergence to weeds and grasses before they reach 4 inches in height.

Remarks There is limited experience with flazasulfuron in Pacific Northwest forests. Numerous herbaceous broad-leaved weeds and grasses are controlled with both a pre- and post-emergence application. Apply over the top or as a directed spray to seedlings that have been seeded (planted) for at least one year. Conifer species labeled as non-sensitive to flazasulfuron include Douglas-fir, noble fir, grand fir and white fir. Other conifer species can be treated providing experience or other data indicates tolerance. Rainfall is required within two weeks after application for best results. Labeled weeds found on forest sites include tall fescue, Italian ryegrass, bentgrass, annual bluegrass, cheatgrass, bedstraw, false dandelion, groundsel species, mare's tail, mustards, spurge species, annual sowthistle, willowweed, bull and Canada thistle. Flazasulfuron also controls cottonwood seedlings. Post-emergent applications benefit from the addition of a surfactant. Other tank mix partners may be needed to obtain best weed control and avoid developing weed resistance.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

flumioxazin (SureGuard, Payload and others)

Rate 0.255 to 0.3825 lb ai/a (8 to 12 oz/a product)

Time Apply preplant or over established seedlings before conifer budbreak.

Remarks Federal supplemental labels allow for use in Oregon, Washington, and Idaho on conifer reforestation sites. This label must be in the possession of the user at the time of application. Flumioxazin controls many broadleaved weeds and certain grasses both pre- and postemergence. Apply before budbreak over seedlings established for at least one year. Douglas-fir, Sitka spruce, grand fir, noble fir, ponderosa pine and lodgepole pine are tolerant. Other species may be treated with local experience. For site preparation wait 3 months after treatment to plant seedlings. The addition of a tank mix foliar herbicide such as glyphosate may be needed to effectively control existing plants for site preparation.

Caution Do not mix with any adjuvant for conifer release.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family N-phenylphthalimide

glyphosate (Rodeo, Roundup Custom and many others)

Rate 0.75 lb ae/a (0.75 quarts/a product) for release; 1.5 to 3 lb ae/a (1.5 to 3 quarts/a product) for site preparation.

Time Apply preplant or over established Douglas-fir seedlings before conifer bud swell or budbreak in the spring or after buds set in late summer or fall.

Remarks There are many glyphosate products labeled for forestry use. Products that have no surfactant in the formulation may be safer over conifers for release in the spring. To control many grasses and broadleaved weeds, apply in the spring over Douglas-fir that has been established for at least one year.

Additional surfactant may increase risk of injury. Glyphosate controls existing plants growing on the site and provides no residual soil activity. For site preparation, apply any time plants are actively growing. Use higher rates and add additional surfactant per label recommendations. For directed spraying around seedlings anytime most product labels allow a 1-2 percent concentration of product in water sprayed to cover vegetation. Avoid contact with conifer foliage or stems.

Caution Douglas-fir can be injured by glyphosate as buds swell and budbreak occurs in the spring. Apply to dormant seedlings to mitigate risk of injury.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

hexazinone (Velpar L, Velpar DF)

Rate 1 to 3 lb ai/a (2 to 6 quarts/a of Velpar L; 1.33 to 4 lb/a of DF formulation)

Time Apply preplant or post plant before conifer budbreak.

Remarks Hexazinone is a soil active product; apply in mid-late spring on high rainfall sites or spring or fall on high elevation, high snowfall sites. Too much precipitation can dilute or negate effectiveness. Hexazinone controls a wide variety of germinating and established grasses and broadleaved weeds. Some woody plants like manzanita and Ceanothus species can be killed or partially controlled on drier sites. Best results occur when they are small. For herbaceous weed control over conifers, rates less than 2 lb ai per acre have been adequate and less damaging. Rates above 2 lb ai/a can injure or kill conifers and are best suited to established ponderosa pine and Douglas-fir where shrub control is wanted on drier sites. Not all conifer species are tolerant. Cedars, redwood, sequoia, larch, white pine, and sugar pine can be severely injured or killed. A suitable foliar herbicide may be needed as a tank mix partner to achieve the best weed control.

Caution Newly planted seedlings, especially container seedlings, can be more sensitive to hexazinone and can be injured or killed. Use lower rates on coarse soils and apply after soils have settled around the roots to help mitigate risk of injury.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazinone

indaziflam (Esplanade F)

Rate 0.73 to 1.46 oz ai/a (3.5 to 7 oz/a product)

Time Apply preplant as a site preparation treatment or after planting and before conifer budbreak or after bud set.

Remarks Indaziflam is a preemergent herbicide that controls certain broadleaf weeds and grasses such as downy brome (cheatgrass). It requires at least 0.25 inches of rainfall to activate. Emerged plants at the time of spraying will not be controlled and may require an additional herbicide active on those species. Best results can be expected on clean sites free of existing vegetation and slash. Conifer species tolerant to broadcast, over the top applications include Douglas-fir, ponderosa pine, sugar pine and coast redwood. White and red fir may be injured or killed. The previous listed conifers plus western larch can be planted into areas sprayed as a site preparation. Other conifer species can be treated or planted if prior experience indicates tolerance.

Caution Total Esplanade F rate applied in a 12 month period must not exceed 10 oz/a. For aerial applications, a 25 foot buffer must be established around lakes, streams, rivers, marshes,

estuaries and fish ponds. Do not apply to frozen or snow covered soil or soil with standing water except as stated on the label.

Site of action Group 29: cellulose biosynthesis inhibitor

Chemical family Alkylazine

pelargonic acid (Scythe)

Rate 3 to 10 percent solution v/v in water to make 75 to 200 gallons spray solution per acre.

Time Apply to green foliage any time it is present on use sites.

Remarks Scythe is a non-translocated contact herbicide for burndown of green weed and grass foliage. Woody stems, seeds and root systems are not controlled and repeat applications on recovering foliage will be needed to maintain vegetation control. Apply as a site preparation treatment prior to planting or as a directed spray to weeds and grasses around conifer seedlings. Use lower concentrations on small succulent weeds and higher concentrations for maximum burndown on perennial species. Overspray on conifers or other desirable vegetation may result in injury. Best control results from complete coverage of target foliage. Pelargonic acid can be used as a tank mix partner with other foliar and soil residual herbicides at reduced concentrations.

Caution This product will damage desirable conifer seedling foliage or other non-target vegetation if they are contacted with any overspray or droplet drift.

Site of action Group 26: unknown

Chemical family Carboxylic acid

penoxsulam + oxyfluorfen (Cleantraxx)

Rate 0.031 to 0.046 lb ai/a penoxsulam + 1.47 to 2.21 lb ai/a oxyfluorfen (3 to 4.5 pints/a product)

Time Apply preplant for site preparation or post plant before conifer budbreak between early fall and late winter.

Remarks Available for use through Special Local Need labels for Oregon and Washington. These labels must be in possession of the user at the time of application. Provides both preemergent and some early postemergent control of certain broadleaf weeds like woodland groundsel and false dandelion, as well as grasses. Germinating seeds of woody plants like manzanita and Ceanothus spp. (deer brush, snowbush, and squaw carpet) may also be controlled. Activation by at least 0.5 inches of rainfall within 21 days of application is needed. Best results occur when applications are made prior to weed germination or when weeds are less than 4 inches tall. Postemergent applications require additions of a surfactant, and when applied over conifers, shown to be tolerated by those conifer species. Tolerant conifer species include Douglas-fir, ponderosa pine, sugar pine, incense cedar, white fir and grand fir. Other conifers may be treated with prior experience indicating tolerance. Any soil disturbance after application such as tree planting or machine traffic can disturb the treated layer in the soil and reduce effectiveness. For site preparation, split applications of 2.25 pints/acre in the fall and spring along with additional tank mix herbicides have shown best results.

Caution Buffers of 25 feet must be maintained around lakes, streams and other water sources and commercial fish ponds. For aerial applications, buffers of 150 feet must be maintained around non-targeted vegetable fallow beds, crops, or desirable vegetation. Do not graze or feed treated vegetation to domestic livestock. Do not treat frozen or snow covered ground or

irrigation ditches. Maximum application rate is 4.5 pints per acre per year. Check individual state labels for additional precautions.

Site of action (penoxsulam) Group 2: acetolactate synthase (ALS) inhibitor; (oxyfluorfen) Group 14: protoporphyrinogen oxidase inhibitor

Chemical family (penoxsulam) Triazolopyrimidine; (oxyfluorfen) Diphenylether

Sethoxydim (Segment II)

Rate 0.281 to 0.468 lb ai/a (1.5 to 2.5 pints/a product)

Time Apply preplant or after planting conifers any time of the year when susceptible grasses are small, but especially in the spring when grasses are actively growing and less than 12 inches tall.

Remarks Sethoxydim controls only select annual and perennial grass weeds after emergence, preferably before they are 12 inches tall and optimally less than 6 inches tall. Susceptible grasses include cheatgrass, tall fescue seedlings, orchardgrass seedlings, annual ryegrass, witchgrass, bentgrass and velvetgrass. Fine fescues are tolerant. To control other grasses and broad leaved weeds other tank mix herbicides will need to be added. For broadcast applications, add a crop oil concentrate at 2 pints per acre or a methylated seed oil at 1.5 pints per acre. Consult label for rates of herbicide and surfactant for spot or directed spray applications. Conifer species listed on the label that are tolerant include Douglas-fir, noble fir, grand fir, white fir, Shasta red fir, lodgepole pine, ponderosa pine and coast redwood. Other conifer species can be treated with prior small scale experience or other data indicating tolerance.

Site of action Group 1: acetyl CoA carboxylase (ACC) inhibitor

Chemical family Cyclohexanedione

sulfometuron (Oust XP and others)

Rate 1.5 to 3 oz ai/a (2 to 4 oz/a product)

Time Apply preplant or post plant before conifer budbreak.

Remarks As a soil active product apply in spring on high rainfall sites or spring or fall on high elevation, high snowfall sites. Sulfometuron controls a wide variety of germinating and some established grasses and broadleaved weeds. Applications made to small or less established weeds result in best control. Some species are poorly controlled such as bull thistle, bedstraw, maretail, and woodland groundsel (*Senecio sylvaticus*). Additional tank mix herbicides such as clopyralid may be needed to achieve best results. Most conifer species like Douglas-fir, hemlock, spruce, true firs (*Abies* spp.), and pines are tolerant. Ponderosa pine, cedars, and true firs may show delayed budbreak and shoot growth in the first year.

Caution Use lower rates on cedar species (see label).

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

Hybrid Cottonwood (Hybrid Poplar) Grown for Pulp

Ed Peachey

Revised March 2020

New Plantings

2,4-D amine (many trade names)

Rate 0.24 to 1.43 lb ae/a (0.5 to 3 pints/a)

Time May be applied before or after planting. Apply when weeds are actively growing, preferably before bud stage on annual weeds and at bud stage for perennials. Repeat treatments may be required for less susceptible weeds. Some labels restrict use to one broadcast application per year.

Remarks Controls emerged broadleaf weeds. Glyphosate may be tank-mixed in preplant applications to broaden weed control. May be applied through wick applicators or conventional ground sprayers.

Caution Do not let 2,4-D contact leaves or green tree bark. Avoid drift. Do not apply within 2 days after an overhead sprinkler irrigation or rain, and do not irrigate for 3 days after treatment.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

clopyralid (Transline and other trade names)

Rate 0.125 to 0.25 lb ae/a (0.33 to 0.66 pint/a)

Time Apply to new plantings only after they have several inches of new, healthy growth. Apply as a broadcast spray over the trees, or as a banded or directed spray.

Remarks Consult label for broadleaf weeds that clopyralid can control. Multiple applications may be made as long as total does not exceed 0.5 lb ae/a (1.33 pints/a).

Caution Avoid drift. Rain or irrigation within 6 to 8 hours of application may reduce efficacy. Carefully follow all rotation crop restrictions and other precautions.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

dimethenamid-P (Tower)

Rate 1 to 1.5 lb ai/a (21 to 32 fl oz/a)

Time Apply to new plantings only after they have been watered and the soil has been packed and settled well around the tree roots. Apply as a broadcast spray over the trees or as a banded or directed spray.

Remarks May be applied during site preparation and establishment. Make sure planting slit is well closed and herbicide does not contact tree roots. Apply prior to weed emergence.

Caution Do not apply during budbreak.

Site of action Group 15: inhibits cell growth and division

Chemical family Chloroacetamide

dimethenamid-P + pendimethalin (Freehand 1.75G)

Rate 1.75 to 3.5 lb ai/a (100 to 200 lb product/a)

Time Apply to new plantings only after they have been watered and the soil has been packed and settled well around the tree roots. Apply prior to weed emergence.

Remarks May be applied during planting and establishment. Make sure planting slit is well closed and herbicide does not contact tree roots. Rain or overhead irrigation is necessary to move the herbicide into soil.

Site of action Groups 15 and 3: inhibits cell growth and division and microtubule assembly inhibitor

Chemical family Chloroacetamide and dinitroaniline

diuron (Direx and other trade names)

Rate 0.8 to 2.4 lb ai/a. Use lower rates (0.8 to 1.6 lb ai/a) on coarse soils.

Time Apply before weeds emerge, or while they are small.

Remarks Labels may differ among products. Use lower rates on coarse soil. Rain or overhead irrigation is necessary to move the herbicide into soil. May apply prior to or after planting. If applying after planting, prevent treated soil from coming in contact with roots during the planting operation. If buds are beginning to swell, direct application, and use shields to keep spray off of buds and any green tissue. If weeds are present at time of treatment, add a surfactant at 1 to 2 quarts/100 gal of solution.

Caution Do not use on gravelly soils, or on any soil with less than 0.5% organic matter. Sprinkler irrigation might injure trees in coarse soils. Do not apply to stressed trees; injury may occur. Do not apply to frozen soils.

Site of action Group 7: photosystem II inhibitor

Chemical family Substituted urea

flumioxazin (Redeagle, SureGuard)

Rate 0.25 to 0.38 lb ai/a (8 to 12 oz/a product)

Time Apply during site preparation prior to transplanting. For optimal weed control, apply before weed emergence or after a burndown herbicide has controlled existing vegetation.

Remarks Rain or overhead irrigation is necessary to move the herbicide into soil. Mechanical incorporation is not recommended.

Caution Transplant operations must take place at least 3 months after application.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family N-phenylphthalimide

glufosinate (Finale VU)

Rate 0.5 to 1.5 lb ai/a, depending on weed species and size.

Time Apply before planting, for site preparation.

Remarks May be used to control weeds before planting. Prepare ground early to allow maximum weed emergence. May include

methylated seed oil (MSO) at 1% v/v or non-ionic surfactant (NIS) at 0.25% v/v spray solution. The addition of 8.5 to 17 pounds of ammonium sulfate (AMS) per 100 gal of water may result in better weed control.

Caution May plant as early as 12 hours after application.

Site of action Group 10: inhibits glutamine synthetase

Chemical family Phosphinic acid

glyphosate (many trade names)

Rate 1.5 to 3.75 lb ae/a, depending on weed species.

Time Apply before planting, for site preparation.

Remarks May be used to control weeds before planting. Prepare ground early to allow maximum weed emergence. Mix 1 quart or more nonionic surfactant per 100 gal of spray solution. Use surfactant with more than 50% ai. Surfactants with less than 50% ai require a higher surfactant volume per 100 gal of spray solution.

Caution Using this product without surfactant may reduce performance.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

metsulfuron methyl (Escort XP and other trade names)

Rate 0.3 to 1.2 oz ai/a (0.5 to 2 oz/a product)

Time Apply prior to planting or over the top after planting, before seedlings have broken dormancy (prior to bud break), and after soil has settled around the roots.

Remarks Rain or overhead irrigation is required to move herbicide into soil. Weed control is best when applying just prior to, or shortly after weed emergence.

Caution Do not apply after bud break. Surfactant is not recommended when applying over the tops of trees. When applying after planting, make sure adequate rainfall has occurred to close planting slit and close soil around the roots. Do not apply to trees under stress from low fertility, disease, insect damage, severe weather conditions, or water-saturated soils; tree injury or death may occur.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

oxyfluorfen (Goal, Galligan, and other trade names)

Rate 1 to 1.5 lb ai/a before bud break.

Time Apply after planting to dormant cottonwood cuttings.

Remarks Direct spray to base of cottonwood tree. For best control, apply before weeds emerge. Adding 1 quart/100 gal spray mix of nonionic surfactant enhances control of emerged weeds.

Caution Applications after bud break may injure crop.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family Diphenylether

paraquat (Gramoxone, Firestorm)

Rate 0.5 to 1 lb ai/a

Time Apply before planting, for site preparation.

Remarks May be used to control weeds before planting. Prepare ground early to allow maximum weed emergence. Good spray coverage is essential for good weed control. Plant with minimal soil disturbance. Add 1 pint of nonionic surfactant or 2 pints of crop oil concentrate to 100 gal of spray mix. Apply in at least 20 gal/a spray volume.

Caution Paraquat is a restricted-use herbicide.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

pendimethalin (Pendulum Aquacap and other trade names)

Rate 2 to 4 lb ai/a

Time Apply after planting, before weed seed germinates.

Remarks Will not control established weeds. Apply after planting when soil around trees has settled. Rate applied determines the length of residual control.

Caution Do not let pendimethalin contact developing roots, because roots may be stunted.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

quizalofop P-ethyl (Assure II)

Rate 0.034 to 0.068 lb ai/a (5 to 10 fl oz/a)

Time Apply to annual or perennial grasses listed on label at optimum use rates based on weed size.

Remarks May be applied over poplars at planting, to aid in establishment. Always use either a nonionic surfactant at 1 quart/100 gal or a petroleum-based crop oil at 1 gal/100 gal.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

saflufenacil (Detail)

Rate 0.022 to 0.13 lb ai/a (1 to 6 fl oz/a product)

Time Apply at least 2 months prior to planting trees.

Remarks Include methylated seed oil (MSO) at 1% spray volume. Does not control grass weeds. Rain or overhead irrigation is required to move herbicide into soil. Rate used will determine the length of residual control. Can be applied with glyphosate to improve speed of burndown and control of some glyphosate-tolerant species, such as horseweed.

Caution Observe buffer zones on label to avoid drift injury to sensitive crops and other vegetation.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family Pyrimidinedione

terbacil (Sinbar, Sinbar WDG)

Rate 0.8 to 1.6 lb ai/a

Time Apply in late winter or early spring before weeds emerge, or while weeds are small. May apply before or after planting, but prior to bud swell. If applying after planting, allow soil to settle well around roots before application. May use only as a directed spray after bud swell.

Remarks Use lower rates on coarse soil. Rain or overhead irrigation is needed to move herbicide into soil. If weeds are present at time of treatment, add a surfactant at 1 to 2 quarts/100 gal of solution.

Caution Do not use on gravelly soils, or on any soil with less than 0.5% organic matter. Sprinkler irrigation might injure trees in coarse soils. Do not apply to frozen soils. If applying after bud swell, keep spray off of foliage, and apply as a directed spray only. Do not plant treated areas to any other crop for 2 years after last application.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

trifluralin (Treflan HFP, Trust and other trade names)

Rate 0.5 to 1 lb ai/a

Time Apply before planting and thoroughly incorporate into top 2 to 3 inches of soil by cross-disking or rototilling.

Remarks Apply to trash-free and clod-free soil. Rate of application depends on soil type and organic matter. Incorporate into soil within 4 hours of application using equipment that ensures thorough soil mixing. Granular formulations may be activated with 0.5 inches rainfall or sprinkler irrigation without the need to mechanically incorporate. Will not control established weeds.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

Established Plantings**2,4-D amine (many trade names)**

Rate 0.24 to 1.43 lb ae/a (0.5 to 3 pints/a)

Time Apply when weeds are actively growing, preferably before the bud stage of growth on annual weeds and at bud stage of growth for perennials. Repeat treatments may be required for less-susceptible weeds. Some labels restrict use to one broadcast application per year.

Remarks To control emerged broadleaf weeds.

Caution Do not let 2,4-D contact leaves or green tree bark. Avoid drift. Do not apply within 2 days after overhead sprinkler irrigation or rain; do not irrigate for 3 days after treatment. May be applied through wick applicators or conventional ground sprayers.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

clopyralid (Stinger, Transline and other trade names)

Rate 0.125 to 0.25 lb ae/a (0.33 to 0.66 pint/a)

Time Apply as a broadcast, banded or directed spray to established plantings, or to new plantings only after they are well established with several inches of new healthy growth.

Remarks Consult label for list of broadleaf weeds that clopyralid will control. Multiple applications may be made as long as total does not exceed 0.5 lb ae/a (1.33 pints/a). When spot spraying, direct spray to keep it off the foliage, or to contact only the bottom or lower branches.

Caution Avoid drift. Rain or irrigation within 6 to 8 hours of application may reduce efficacy. Carefully follow all rotation crop restrictions and other precautions.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

dichlobenil (Casoron 4G and CS)

Rate 2 to 4 lb ai/a (50 to 100 lb/a 4G, 1.4 to 2.8 gal/a CS)

Time Apply to soil surface from mid-November through mid-February to trees established at least 6 months.

Remarks Spot treatments to control emerged weeds may be made as late as mid-May. Rain is required to move herbicide into the soil. Use is restricted to desert areas of Oregon (2 counties) and Washington (3 counties).

Caution Do not use on trees established less than 6 months. Do not allow granules to stick to tree leaves or to accumulate at soil line around base of stem.

Site of action Group 20: inhibits cell wall synthesis Site A

Chemical family Nitrile

dimethenamid-P (Tower)

Rate 1 to 1.5 lb ai/a (21 to 32 fl oz/a)

Time Apply as a broadcast spray over the trees or as a banded or directed spray. Apply prior to weed emergence.

Remarks Rain or overhead irrigation is necessary to move the herbicide into soil.

Caution Do not apply during budbreak.

Site of action Group 15: inhibits cell growth and division

Chemical family Chloroacetamide

dimethenamid-P + pendimethalin (Freehand 1.75G)

Rate 1.75 to 3.5 lb ai/a (100 to 200 lb product/a)

Time Apply prior to weed emergence.

Remarks Rain or overhead irrigation is necessary to move the herbicide into soil.

Site of action Groups 15 and 3: inhibits cell growth and division and microtubule assembly inhibitor

Chemical family Chloroacetamide and dinitroaniline

diuron (Direx and other trade names)

Rate 0.8 to 2.4 lb ai/a. Use lower rates on coarse soils (0.8 to 1.6 lb ai/a).

Time Apply before weeds emerge, or while they are small.

Remarks Labels may differ among products. Rain or overhead irrigation is necessary to move the herbicide into soil. If weeds are present at time of treatment, add a surfactant at 1 to 2 quarts/100 gal of solution. If applying after buds have swollen, direct application to keep spray off buds and any green tissue.

Caution Do not use on gravelly soils or on any soil with less than 0.5% organic matter. Sprinkler irrigation might injure trees in coarse soils. Do not apply to stressed trees; injury may occur.

Do not apply to frozen soils. Do not plant treated areas to any other crop for 2 years after last application.

Site of action Group 7: photosystem II inhibitor

Chemical family Substituted urea

flumioxazin (Redeagle, SureGuard)

Supplemental label for Oregon, Washington, and Idaho only

Rate 0.25 to 0.38 lb ai/a (8 to 12 oz/a product)

Time Apply preemergence, or early postemergence, before weeds are more than 2 inches tall.

Remarks Include a surfactant when applying to emerged weeds. Rain or overhead irrigation is necessary to move the herbicide into soil. Mechanical incorporation is not recommended.

Caution Do not apply to trees transplanted or established less than 1 year. If applying after bud swelling, injury may occur if spray contacts foliage. Direct applications toward soil and away from any green bark or foliage, and use a spray shield to avoid injury. When applying release treatments do not include any adjuvant or fertilizer. Do not apply more than two applications at 12 oz/a or 3 applications at 8 oz/a per year. Do not re-apply within 30 days.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family N-phenylphthalimide

glyphosate (many trade names)

Rate 1.5 to 3.75 lb ae/a, depending on weed species

Time Apply as a postemergence directed spray or spot treatment to emerged weeds.

Remarks For formulations without surfactant, mix 1 quart or more nonionic surfactant per 100 gal of spray solution. Use surfactant with more than 50% ai. Surfactants with less than 50% ai require a higher surfactant volume per 100 gal of spray solution. Add ammonium sulfate to spray solution to prevent hard water tie up of herbicide.

Caution Using this product without surfactant may reduce performance. Avoid contact of spray, drift, or mist to green bark or foliage. Desirable trees may be protected by using shields or protective coverings to keep spray solution off bark and foliage. Do not use as an over the top broadcast spray.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

metsulfuron methyl (Escort and other trade names)

Rate 0.3 to 1.2 oz ai/a (0.5 to 2 oz/a product)

Time Apply before trees have broken dormancy (prior to bud break).

Remarks Rain or overhead irrigation is required to move herbicide into soil. Weed control is best when applying just prior to, or shortly after, weed emergence.

Caution Do not apply after bud break. Surfactant not recommended when applying over the tops of trees. Do not apply to trees under stress from low fertility, disease, insect damage, severe weather conditions, or water-saturated soils; tree injury may occur.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

oryzalin (Surflan AS, Surflan Flex)

Rate 2 to 6 lb ai/a

Time Apply to weed-free soil.

Remarks Apply only to established plantings, which the Surflan label defines as those that have been transplanted into their growing location long enough that soil has firmly settled around the roots from packing and rain or irrigation; 0.5 inch of moisture (rain or sprinkler irrigation) needed to activate. Lower rate controls for 2 to 4 months, higher rates for 4 to 12 months. May apply up to 12 quarts/a per year. Allow 2.5 months or more between applications. May apply by chemigation if the irrigation system keeps water under the leaf canopy.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

oxyfluorfen (Goal, Galigan and other trade names)

Rate 1 to 1.5 lb ai/a before bud break.

Time Apply prior to bud swell.

Remarks Direct spray to base of cottonwood tree, and avoid spray or spray mist from contacting any green bark or foliage. For best control, apply before weeds emerge. Adding 1 quart/100 gal spray mix of nonionic surfactant enhances control of emerged weeds. May apply as one application, or as a split application with a total of 1.5 lb ai/a per season. Apply in 50 gal water/a or more to reduce injury to crop.

Caution Applications made after bud break may injure crop.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family Diphenylether

pendimethalin (Pendulum Aquacap and other trade names)

Rate 2 to 4 lb ai/a

Time Apply to weed-free soil.

Remarks Will not control established weeds. Rate applied determines length of residual control.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sethoxydim (Nufarm Sethoxydim SPC, Segment, Segment II)

Rate 0.28 to 0.47 lb ai/a (2.25 to 3.75 pints/a of Nufarm Sethoxydim SPC and Segment, 1.5 to 2 pints/a of Segment II)

Time Apply to susceptible annual or perennial grasses listed on label at optimum use rates based on weed size.

Remarks Identify susceptible grass species. Tolerant grasses include annual bluegrass and all fine fescues. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Segment does not require adding an adjuvant. Check Sethoxydim SPC and Segment II labels for appropriate adjuvants.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

sulfometuron (Spyder, Oust XP and other trade names)

West of the Cascades in Washington and Oregon only

Rate 0.375 to 0.94 oz ai/a (0.5 to 1.25 oz/a product)

Time Apply to soil surface of dormant trees established for at least 1 year.

Remarks Rain or overhead irrigation required to move herbicide into soil.

Caution Avoid applications from bud swell to leaf drop when trees are actively growing. Do not let spray contact green bud or leaf tissue; injury may result. Limit first use to determine selectivity on specific clone. Do not apply to trees under stress from low fertility, disease, insect damage, severe weather conditions, or water-saturated soils; injury may occur.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

terbacil (Sinbar WDG)

Rate 0.8 to 1.6 lb ai/a

Time Apply in late winter or early spring before weeds emerge, or while they are small. For applications after bud swell, keep spray off of foliage, and apply as a directed spray only.

Remarks Use lower rates on coarse soil. Rain or overhead irrigation is needed to move herbicide into soil. If weeds are present at time of treatment, add a surfactant at 1 to 2 quarts/100 gal of solution.

Caution Do not use on gravelly soils or on any soil with less than 0.5% organic matter. Sprinkler irrigation might injure trees in coarse soils. Do not apply to stressed trees; injury may occur. Do not apply to frozen soils. Do not plant treated areas to any other crop for 2 years after last application.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

trifluralin (Treflan HFP, Trust and other trade names)

Rate 1 to 4 lb ai/a incorporated into soil. Consult appropriate label for rates. Adjust rate according to weed pressure.

Time Apply before weeds emerge.

Remarks Apply as a directed spray to soil between rows and beneath trees. Apply to trash-free and clod-free soil. Incorporate into soil within 4 hours of application using equipment that ensures thorough soil mixing but will not injure the trees. Granular formulations may be activated with 0.5 inches of rainfall or sprinkler irrigation without the need to mechanically incorporate. Will not control established weeds.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline
